



The Blast Furnace and Steel Plant

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The Blast Furnace *and* Steel Plant

Vol. X

PITTSBURGH, PA., FEBRUARY, 1922

No. 2

Eastern Steel Company New Blast Furnace

Description of New Furnace Recently Built for This Company at Pottstown, Pa.—A Historical Review of the Activities of the Eastern Steel Company.

By RICHARD PETERS, JR.*

THE Bard of Avon in one of his best known plays used the oft-quoted query, "What's in a name?" The answer to the question as applied to the pig iron industry may be found in the zealous guarding of time-tried brand names of the products of blast furnaces. The earliest iron masters originated the custom of giving personal appellations to their works and the iron made was likewise identified. This practice has been continued to the present time, and while it is true that the more enlightened foundrymen of today lay more stress on the chemical feature of their iron, yet it may be said that they also have great faith in the trade name.

It is therefore of singular interest to know that "Warwick" as a brand has been almost continually used in the eastern district for nearly two centuries, outliving the vicissitudes of time and changing conditions of the industry.

Construction of the original Warwick furnace was started in 1737 and the plant was first operated in the following year. It was located on the south branch of French creek in Chester County, Pa., about 10 miles southwest of Pottstown, where the remains of the furnace are still to be seen. This early plant was probably the largest operating in the colonies and made many castings for the early husbandry. It is credited with having cast the first of the stoves invented by Benjamin Franklin.

In the Revolutionary period the furnace was actively engaged in casting cannon for the Continental army, and during the activities of Howe's troops in the vicinity of Philadelphia some of the Warwick cannon were buried for safety on the furnace property. In the early fall of 1777, before Washington met the British at Brandywine, the American army was encamped for a time at Warwick. The subsequent operations of the furnace are woven into the early history of iron making in Pennsylvania, and the narratives of American manufacture of 60 years ago give prominence to the enterprise at Warwick. It was not until the year 1867 that the furnace made its last blast which was probably due to the increasing difficulties of obtaining charcoal, and also to a great degree in the fact of its inaccessible location with respect to changing methods of manufacture.

Following a successful campaign of over a century and a quarter, it seemed natural when a new iron enterprise was formed in the vicinity that the projectors

should seize the opportunity of perpetuating the name of Warwick. Accordingly we find that on March 30, 1872, a charter was granted to the Warwick Iron Company which was headed by Jacob H. Gabel as first president. The actual construction of the new furnace was begun in 1875 and the first blast put on in the following

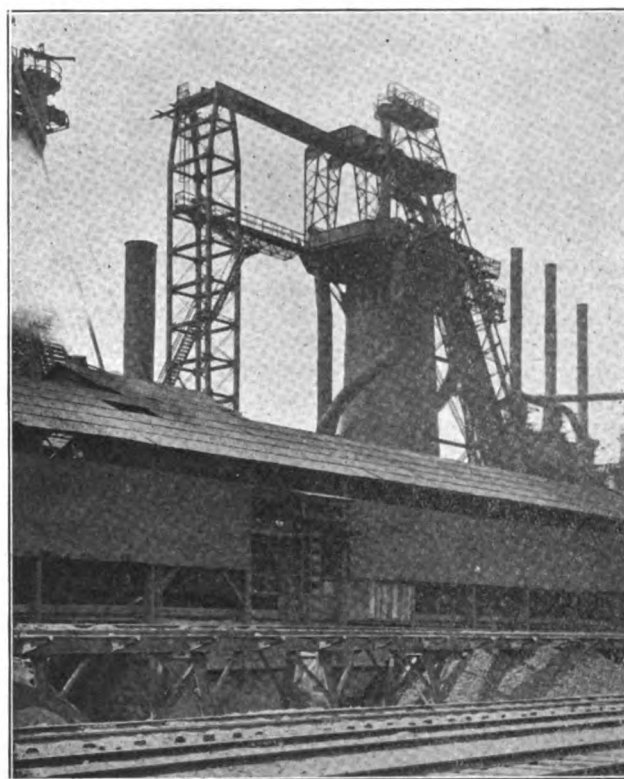


Fig. 1—General view of new blast furnace, showing skip bridge with independent shear leg support.

year. The stack, which was built of brick, banded with iron hoops, rested on masonry columns, and its dimensions were 55 feet in height with a bosh diameter of 16 feet. The furnace was blown with six tuyeres, the blast being supplied by a single 96x40 by 7-ft. stroke non-condensing engine, while the air was heated in two iron pipe stoves. The ores used were mainly local and the fuel principally anthracite coal.

The starting of the plant was attended with great

*Mr. Peters is manager of sales of the Pulaski Iron Co.

operating difficulties due to indifferent management, but fortunately for the owners of the property they obtained the services of Edgar S. Cook in 1877. Mr. Cook was at that time in charge of the Monocacy furnace a few miles above Pottstown, and had displayed remarkable ability as a young man in blast furnace practice. Shortly after taking charge at Warwick, Mr. Cook installed a chemical laboratory at the furnace which was one of the first steps in this direction in the east.

With the aid of technical advice from the late John Birkinbine, Cook made changes in the lines of the furnace which with other improvements raised the production of iron from 190 to 350 tons per week. From December, 1880, the furnace started on a campaign which lasted five years, the output averaging over 100 tons per day, and under Cook's management the plan proceeded upon a successful career. In 1892, after a careful investigation of fire brick stoves then in use, Mr. Cook installed a set of three Hugh Kennedy type each 20 by 60 feet, replacing the iron stoves of the Durham pattern. This radical change brought forth both friendly criticism and skepticism from the leading anthracite iron masters, who at that time were staunch adherents of the iron type stove. The new stoves were designed by Hugh Kennedy, then manager of the Isabella plant near Pittsburgh, and from outward appearances resembled the ordinary dome top type of the present, except that they were surmounted by a pair of squatty chimneys which gave them an unusual look.

The revival of the iron business following the long stagnation from the panic of '93 brought forth much expansion in the industry, and the Warwick Company followed the order of the day by reorganizing into the Warwick Iron & Steel Company in the summer of 1899. At this time, at Mr. Cook's suggestion, a new furnace was projected and construction was commenced in 1900. The program included an entire new plant to supplement the existing unit, with the additional feature of the installation of a pig casting machine of the Uehling type. The furnace was 100 by 22 feet with four stoves of the same height, and the stack was the first of that size to be built in the east. The late Edward Cook, who at the time of the rebuilding of the plant was assisting his father, told the writer that the lines of the new furnace were obtained by proportionate enlargement of those of the older stack which had done such good work. It was found in actual practice on the new furnace that these lines did not give the desired results, and several changes had to be made before the furnace gave satisfactory grades and output.

Mr. Cook was an early advocate of machine cast pig iron and did much pioneer work in the introduction of this character of metal into the mixture of those foundrymen who were inclined to be skeptical of the results from changes of long time practices. Not content with his many bold strides toward developing modern methods at a merchant furnace plant, Cook installed a Galey dry-blast system shortly after the results of the experiments at Isabella had been exploited. The Warwick Company had for some 15 years kept complete records showing the amount of water entering the furnaces in the form of aqueous vapor, and concluded if a more regular operation of the furnaces could be maintained the cost of the installation would be justified.

Despite the fact that the Warwick Company now had two stacks, they leased and overhauled the old anvil furnace of the Pottstown Iron Company in 1906 in order to satisfy their market. This lease did not prove to be a profitable one on account of local operating difficulties,

and steps were taken to insure the company having available at all times two units. While the original stack had been improved by the replacement of the Hugh Kennedy stoves by those of larger dimensions and of a center combustion type, the company felt that they would be justified in erecting a new furnace to be used as an alternate in the event that either of the two stacks were out of blast. Accordingly a new furnace, known as "A," was constructed of the thin lined type which was located between the two built previously, and arranged to be used with the stove and power equipment of either number one or number two furnace. This unit had the general characteristics of the type much exploited some 10 years ago, and was constructed with the top structure independent from the shell, which was water cooled by means of a spiral trough supplied by the waste water from the tuyeres and bosh plates.

Furnace "A" was practically completed at the time when the Eastern Steel Company made a long time lease on the properties of the Warwick Iron & Steel Company in 1912. With the passing of the management of the properties into other hands the Cooks, father and son, retired from active charge of the furnaces, and their deaths a few years since, closely following each other, removed from the iron world able men with sterling characters.

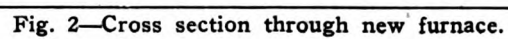
The Eastern Steel Company, desiring to bring the plant strictly up to date, arranged with the owners of the property for the removal of the original number one stack which had not been operated for some years, agreeing to replace the "A" or center furnace with one of a later type.

The contract for rebuilding the "A" Furnace was placed with Arthur G. McKee & Company of Cleveland, and involved a complete new stack and appurtenances. The hearth level of the furnace was raised 4 ft. 7½ in., the foundation being raised and enlarged to support the new stack. The new hearth jacket is of 1½-in. plate, 22 ft. in diameter and 10 ft. high, allowing a hearth diameter of 15 ft., as compared with 14 ft. in the old furnace. Drawing No. 3827 (Fig. 2) shows the sectional elevation of the furnace, furnace top, skip bridge and stock bins. The tuyere jacket is 19 ft. 6 in. inside diameter, 4 ft. 7 in. high of 1-in. plate. The furnace shell is of ¾-in. plate, the mantle ring being of 1-in. plate and heavy angles.

There are eight columns spaced alternately at 50 deg. and 40 deg. angles. This allows the uniform spacing of the 12 tuyeres, two tuyere stocks being placed in the 50 deg. and one in the 40 deg. space. The columns are of structural shapes these being considered more reliable and less bulky than cast iron columns.

The hearth and bosh cooling system consists of eight rows of copper cooling plates. The experience of the engineers has brought out the inadvisability of cooling plates above the mantle, and the construction of recent furnaces with few exceptions bears this out. The hearth brick are also cooled by cast iron cooling plates inside the hearth jacket. The new lining consists of approximately 497,000 fire brick 9 in. equivalents.

The furnace top was entirely rebuilt. A new platform of 5/16-in. plate with solid hand railing is supported by the cast steel furnace top ring and structural brackets. The top structure is notable in that it combines all facilities of a modern furnace top with a compactness and co-relation of parts which is not often realized. The three structural "A" frames supporting the trolley beams are mounted on the platform, two of these forming a tower.



A novel scheme was developed to utilize the old vertical hoist tower of the furnace. This was rebuilt and equipped with stairway and platform and so placed as to support the ends of the trolley beams, thus allowing them to extend to the unusual distance of 68 feet from the center line of the furnace. The trolley has a capacity of 25 tons, sufficient to handle the load of the large bell and hopper taken together.

The large and small bell beams, as shown in the drawing, are supported by the trolley beams, and are pivoted on a single forged steel shaft with special adjustable bearings. The large beam only is counterweighted, the additional counterweights being provided at the bell cylinders which are placed at the cast house level. The bell beams are connected with the bell cylinders such that the bells open by gravity.

The skip bridge was raised to conform with the new furnace height and the angle steepened from 67 deg. to 71 deg. 47 min. with the horizontal. The bridge is supported by a shear leg independent of the furnace stack, and has a plate deck under the rails. At the top of the bridge is an auxiliary trolley beam for handling the bell beams. The hoist house is under the skip bridge and the skip ropes brought through the bridge by guide sheaves as shown in the drawing.

The new large bell is of cast steel 11 ft. 3 in. in diameter with 50 deg. slope. The large bell rod is forged steel 5 in. in diameter. The stock distribution is accomplished by a McKee revolving distributor, equipped for automatic recurrence of a six skip, six position cycle.

Four new downcomers were provided, connecting to the old pipes. The downcomer connections at the top of the furnace are of the McKee patented type and are made up of cast steel. These downcomers serve as a preliminary dustcatcher in that the gas must turn at a sharp angle in order to pass the baffle and enter the vertical outlet, thus causing the particles of stock carried with the gas to strike the end of the inclined pipe, or the baffle casting, and roll back into the furnace. The arrangement of downcomer castings is shown in Fig. 1. One bleeder 36 in. in diameter by 41 ft. high was installed.

Three 75-ton hot metal ladle cars were purchased and put in operation. These are of the mixer type and are motor operated.

All of the engineering and reconstruction work was done by Arthur G. McKee & Company on a lump sum contract. The supervision of the design and construction was handled for the owners by S. O. Hobart, manager, and his assistants.

Disintegration of Blast Furnace Linings

We Invite Discussion of This Subject Through The Blast Furnace and Steel Plant—Brick Makers Should Make Experimental Tests to Find Resistance of Various Makes of Brick to Zinc Fumes

By P. O. MENKE*

General Supt., Shenango Furnace Co., Sharpsville, Pa.

WITHIN recent years the blast furnace men have become more or less alarmed over the repeated failures of blast furnace linings. The first few failures were confined to a certain well known brand of steam pressed brick. Shortly afterward we heard of other well known and popular makes of furnace linings giving out. All of these early failures were confined to steam pressed linings, but later there has been found disintegration in some well known hand made linings. The probable reason that the failures have not been more numerous in the hand made brick is on account of the popularity of steam pressed linings in recent years.

There is no doubt that the quality of most of the popular brands of fire brick has greatly deteriorated during the last five or six years, principally due to careless and inefficient labor, over which the maker had no control, but some of this is probably also due to mixing in some inferior clays. The proportion of plastic clay was increased beyond the former usual ratio. The flint clays were ground finer in order to make a nice looking brick; in fact, most of the furnace men in recent years have laid too much stress on getting a smooth, nice looking fire brick that would lay up nicely, with minimum cutting and labor. Nevertheless, all of the aforesaid changes should not account for all of the trouble.

*Paper read before The Eastern States Blast Furnace and Coke Oven Association.

During the early part of this year, while visiting a large eastern plant, my attention was drawn to some shell failures. Some of these were on light shells, but one of these cracked shells was built out of 1-inch plate, well riveted and butt strapped, in every way a first class job. It had a steam pressed lining laid against the shell without any packing space. This shell had started to split vertically several sheets above the mantle. At the time this was attributed to the probable expansion of the steam pressed brick. I was alarmed, due to the fact that we have been laying our steam pressed linings against the shell for some years past, first on one of our furnaces which had a 1-inch shell, afterward on a furnace with a ¾-inch shell and two furnaces that had ½-inch shells. These furnaces have been operating that way for seven years or more, and as yet show no signs of rupturing the shell.

On looking over the aforementioned shell, I noticed some secretion at the point of fracture which looked like a deposition of zinc fumes. It struck me at once that this might be a case of zinc impregnation of brick work. I suggested having the secretion analyzed for zinc, in addition to taking a drilling through the crack and having some of this brick material analyzed. We have heard later that zinc was found.

Also found that it was no uncommon occurrence to burst furnace shells in that part of the state; in fact, it

was such a regular thing at one plant that it led to the design of a very ingenious banding lug for banding shells whenever they showed signs of giving way. Shortly afterward, we read and heard of a very bad shell failure with fatal results, which was generally attributed to an explosion. As this mishap was so unusual and of such fatal consequence, it had most all of the furnace men alarmed who heard of it.

On a visit shortly after and on seeing photographs of this wreck, it seemed to me I could see action of zinc impregnation and disintegration. The manager assured me there was no zinc, as he did not use any zinc bearing raw material. On examining this furnace we found a distinct vertical separation and cleavage of the remaining portion of the inwall. Although we could not detect any metallic zinc, I was quite sure I could see particles of zinc oxide in this cleavage. On some of this brick material being analyzed later, zinc was found in the form of oxide, chloride and metallic, as high as 40 per cent down to .15 per cent.

With zinc impregnation as high as shown in the foregoing analysis it does not seem unreasonable at all, knowing the terrific strain that a zinc saturated lining exerts, to have split this shell, particularly so as it was water cooled. I believe that this shell also had a splash jacket which prevented the operators from promptly detecting any signs of splitting of the furnace shell under the splash jacket. With the split shell it would not necessarily take a very heavy slip to put on enough additional strain to tear horizontally and open up.

We shoveled out some furnaces that had been banked for several months. On examining linings, we found one of them had a considerable belly, extending from the mantle to 30 feet above the mantle, reaching less than one-third of the way around the furnace. On digging in to get a footing for a patch we found the brick wall glazed and hard for a depth of from 4 to 1 inches back of the inner face of the lining. Beyond that, we found a zone of separation and spalled cleavage for a distance of from $\frac{1}{4}$ inch to 2 inches. This space was filled with zinc oxide, metallic zinc and large carbon deposits; zinc from 2 to 20 per cent. Beyond that, for a distance of from 2 to 4 inches, the brick was disintegrated and crumbly, saturated to the extent of from .03 to 6.28 per cent of Zn. Beyond that point, extending to the shell, the brick was firm and in a good state of preservation, with practically no zinc impregnation. The balance of the lining seemed very good. It had worn back less than 2 inches of the original dimensions.

We cut two test holes through the good lining back to the shell, opposite the bad place. Found no disintegration. The face of the brick was glazed and firm, and really harder than it would be in the original state. Found metallic zinc in the joints, also some oxide of zinc about 12 inches back from inner face of lining, but this had in no way penetrated the brick.

As we have had some spray cooling on outside of shell on the thin spot of this furnace, we laid the disintegration at this point to this cooling effect. This furnace was lined up with the same make of steam pressed brick that had given us over 800,000 tons the preceding blast, and was in good serviceable condition when blown out.

On finding this condition at this furnace we cut some test holes above the mantle at our other furnace that had been lined up with the hand made brick of a popular make. This lining had been stored in our brick shed over five years, so must have been made at a time before

we heard much of disintegration of furnace linings. We found the inner face well glazed and firm for a distance of about 4 inches. From there on we found zinc, both metallic and oxide, and disintegration to the extent of making the brick soft and very easy to cut, to within 4 or 5 inches of the shell. The conditions were identical at the two opposite points of the furnace. We made no repairs, but plugged the holes, and this furnace is operating today.

On the strength of these observations closer investigation in our district of some of the most prominent cases of disintegration was made. We found in one particular case where they had lost two linings that they had found zinc up to 18 per cent in this brick. Considerable of this was metallic, but they did not seem to blame the presence of this zinc for the disintegration of their linings.

Our own experience in this matter has been expensive, and the cause of great delay. Nine or ten years ago, on account of low phosphorus contents, our furnaces had used a proportion of Blue Billy agglomerates in our burden. First split one shell on the smaller furnace which had seen considerable service. This shell had to be renewed. Within two years our larger, newer furnace opened up her shell both in the vertical and horizontal seams, in the heavy section. We promptly banded this furnace. She burst these bands until we put on 12x1 $\frac{1}{2}$ -in. bands, very closely spaced. After that, sheared the horizontal seams of the shell, and showed swellings and distortions on the side of the furnace. This furnace was excessively water cooled in the bosh. Also had cooling plates above the mantle. Most of the trouble and breaks in shell took place in the cooled zone. We had more or less metallic zinc around the bosh plates most of the time.

We found it necessary to put this furnace out for renewal of stack. Did not get a chance to blow this furnace down more than 35 feet, as the furnace shook so badly as to make it unsafe. On taking this lining out we found the most complete disintegration we had ever seen. It was not burned out in any way, but had the full thickness of the lining, in addition to some scabs on the inside. It was not necessary to use any picks or steel bars, but the lining was shoveled out. The full outlines of the brick and joints were visible until we got to the water cooled portion, where the zinc showed up, mostly in the metallic form, due to the water cooling.

On taking analysis of this lining we found up to 49.86 per cent Zn and up to 40 per cent in the scab and scaffold. In fact, lining and scab were so rich in zinc that it was sold to a chemical company for the recovery of the zinc. A considerable portion above the water cooled section was in the form of chloride of zinc.

On finding this condition we put up a 1-inch shell, discontinued the cooling above the mantle, also reduced the cooling below the mantle, and cut out Blue Billy agglomerates and other zinc bearing material. Put in a steam pressed lining laid tight against the shell, and followed the same practice on our other furnaces with the lighter shells. Our results so far have been satisfactory, until we ran into zinc recently. Feel we would not have run into any difficulties even then if we could have kept furnaces running. Banking, shoveling out and cooling largely aggravates this condition.

It might be well to give a brief outline of the action of the zinc in the furnace. Being charged into the top as zinc oxide, finely disseminated through the ore, it descends unchanged to the fusion zone, as the reduction

temperature is 1,000 deg. C. and over. The zinc oxide is reduced by solid carbon to metallic zinc; liberated as vapor, it ascends with the gases to the cooler zones. The zinc is re-oxidized through the temperatures from 1,000 deg. to about 500 deg. C. to the reaction $\text{Zn} + \text{CO}_2 = \text{ZnO} + \text{CO}$ and is carried up by the gases as zinc oxide. The larger portion passes out into the stoves, dust catcher, boilers or into the atmosphere. A portion redeposits on the descending stock to repeat the before-mentioned cycle of changes.

Some of the zinc vapor is absorbed by the lining up to as high as 50 per cent. It usually shows up as small yellow crystals. Sometimes it is found with carbon deposits in the disintegrated and laminated portions of the lining. Some of this zinc shows up in the metallic form. It usually is around the water cooled part of the furnace, also in the part of the lining that is not water cooled but had a chance to cool down after banking or blow out.

In scabs that adhere to the water cooled portion of the furnace, it probably combines with the alumina, forming zinc spinel, which is practically irreducible, as these scabs are mostly still present and intact after the furnace has been blown out. It is also generally assumed that the zinc oxide combines with the alumina in the fire brick. As the coefficient of linear expansion of zinc is like 60 to 1, compared to silica, which is the principal constituent in fire brick and is about 3 to 1 compared to steel, it can

readily be seen that it would not take a great deal of impregnation to destroy the bond of the brick and exert great expansive stresses. The hand made brick, on account of its greater porosity, has a tendency to take up more of this element than the steam pressed.

Most of the Blue Billy agglomerates carry zinc, which can easily be guarded against, but as some limestones carry traces of zinc, also some of the Lake Superior ores, it makes it rather hard to be absolutely sure there is no zinc bearing material charged into the blast furnace. No matter how low the percentage of zinc is in the raw material, on account of its being accumulative, it will eventually show up.

We cannot see why it should in any way be detrimental to lay a lining against the shell without packing space, and particularly so with steam pressed brick which is a good conductor of heat and warms up the shell to a point where it can expand with the brick work, as most blast furnace lining brick should be somewhere near neutral and not subject to a great deal of expansion under heat.

We feel by using a heavy shell (if necessary above 1 inch thick) and cutting out the water cooling above the mantle will cut down the trouble to a minimum. It might also be well for the fire brick makers to make experimental tests to find the resistance of the various makes of brick to zinc fumes.

Otis Steel Company Completes the Erection of a Modern Sheet Mill Department

Features of the New Department Which Is Located at the Company's Riverside Works Are Extra Heavy Mills, Powdered Coal Fuel, Continuous Pair Furnaces and Electric Drive.

By DONALD N. WATKINS.

THE Otis Steel Company of Cleveland Ohio, have added to their present equipment by the erection of a most modern and up-to-date sheet mill department. The new mill is equipped with all modern improvements. This department is located at the Riverside plant in the center of Cleveland. The more important installations in the new plant include extra heavy mills, electric drives, powdered coal fuel, continuous pair furnaces, electric furnace chargers, Baird water cooled floors and other essential equipment.

The hot mills are housed in a steel building 456 ft. long and 90 ft. wide. Running parallel and connected to this building is a bar storage building 456 ft. long and 75 ft. wide. The lean-to over the furnace is 456 ft. long and 26 ft. wide, while the shear building is 456 ft. long and 40 ft. wide. Continuous to the main mill building is the annealing building, 500 ft. long and 80 ft. wide, with a lean-to 340 ft. long and 31 ft. wide. The pickler building is 140 ft. long and 50 ft. wide, while the warehouse is 380 ft. long and 75 ft. wide and has a lean-to over the shipping tracks 380 ft. long and 16 ft. wide. The buildings are of steel construction and are fitted throughout with Lupton steel sash. Kiefer Sheeting & Painting Company of Pittsburgh put on the sheeting and painted

the building. Wood block floors are installed in the pickling and warehouse buildings, while the other floors throughout are of brick.

Special attention has been given to ventilation and good lighting. The main mill buildings are constructed so as to give the best natural lighting.

The sheet mills were built by Mackintosh-Hemphill Company, Pittsburgh, Pa., and consist of eight mills having rolls 30 in. in diameter, and comprising one finishing stand and one roughing stand per mill, thus making a total of 16 stands in the layout.

There are six jump roughing stands with rolls 30x48 in. and six finishing stands with rolls 30x44 in. There are also two balanced roughing stands with rolls 30x54 in., and two finishing stands with rolls 30x54 in.

The mills are driven by two separate motor drives, through suitable gear reductions, and are so arranged that two mills are driven on each side of each motor drive. The mills are of heavy rugged design, the housings being made of cast iron.

Four drag units are provided at the end of each group of two mills and are of the standard Mackintosh-

Hemphill spring type. The balanced roughing stands have motor driven screw downs and the top rolls are balanced by counterweights, underneath the shoes.

One feature with regard to the arrangement of the counterweights is of interest in that the weights are *not* held between the shoes and parallel with them but extend to the side of the mill at right angles to the shoes, which makes it possible to attach a crane to the counterweights and block same up by simply removing a floor plate. A pinion stand of standard design is provided between the two roughing stands for driving the top rolls of the same.

The hot mills are driven through a Falk gear drive with about 8 to 1 reduction and the mills are arranged half on each side of the drive which consists of a 1,000-hp. Allis-Chalmers motor of 2,200 volts, three phase, 25 cycle, 250 rpm.

The electric power is furnished from the company's own power house.

The drive is of the usual Falk construction, consisting of single reduction gears.

The hot mill furnaces were all designed and erected, complete, by the George J. Hagan Company, Pittsburgh, Pa. Fig. 3 gives a front view of the sheet furnaces. Each sheet furnace is of the double compartment type, with center partition wall, and are known as the solid hearth type. The interior area of these furnaces is such

as to give the highest working efficiency without any danger of burning the edges of packs when the sheets are in the furnace on edge. The furnaces are specially

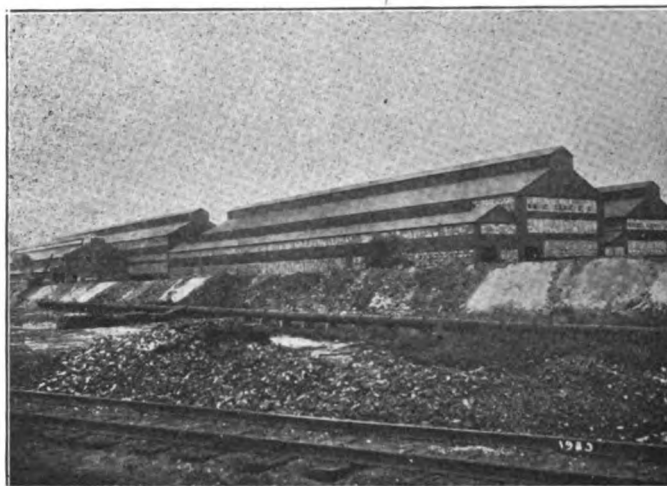


Fig. 1—General view of sheet mill buildings—Southeast elevation.

designed with large flue areas so as to take care of any excess dust or accumulation that may be caused by the use of powdered coal as fuel. All flues are made easily

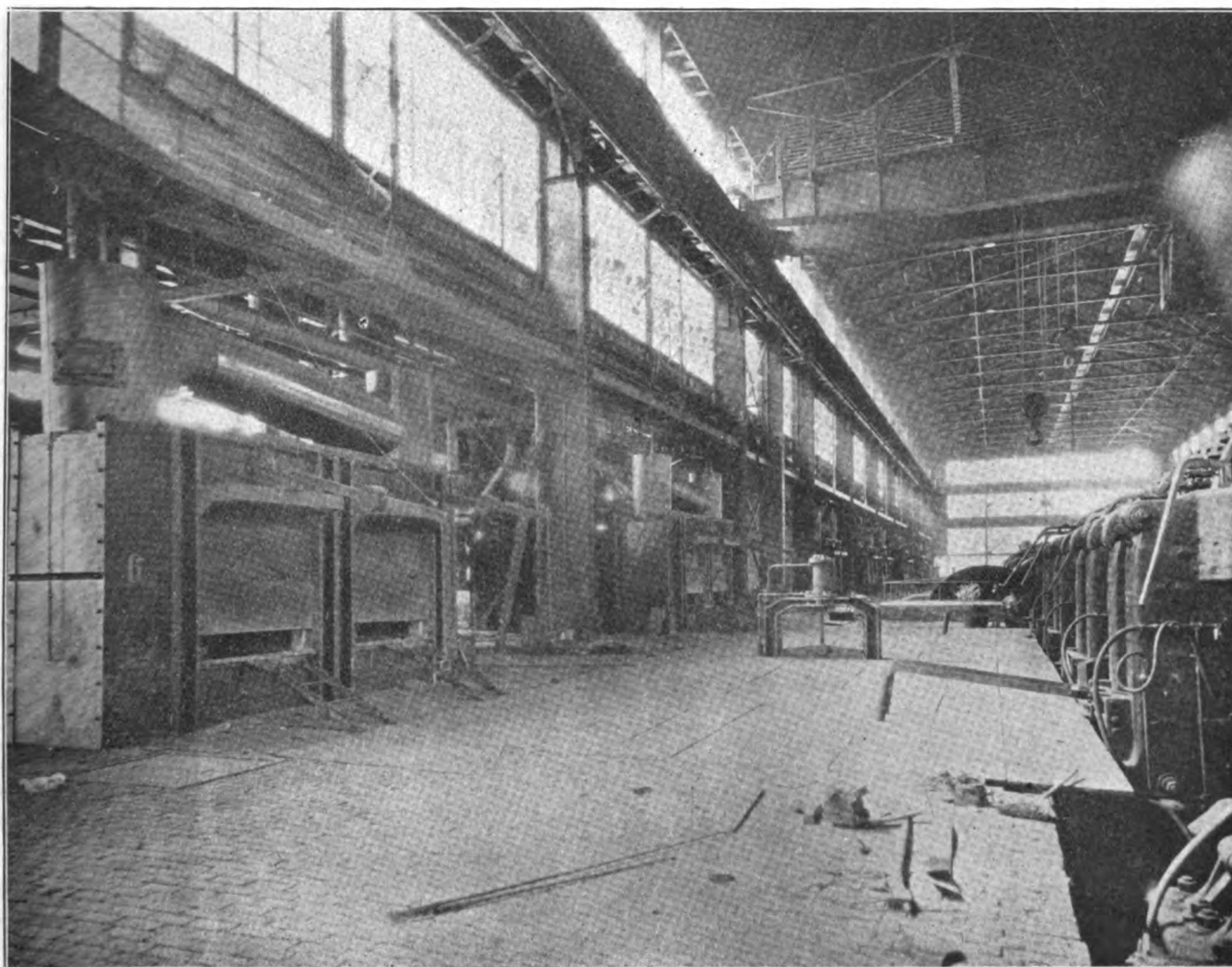


Fig. 2—General interior view of sheet mill building showing mill train.

accessible and very simple arrangements made for cleaning same. The furnaces are all heavily incased with steel plates and castings. There is no brickwork exposed

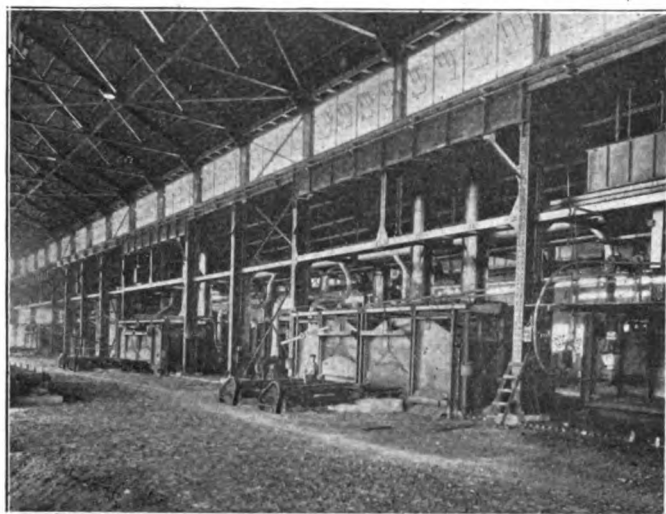


Fig. 3—General view of sheet and pair furnaces, mill side—in mill building.

The sheet furnaces are located approximately 27 feet from the face of doors to the center of hot mill.

Fig. 4 gives a rear view of the Hagan-Allis patented continuous pair furnaces. This photograph shows the very simple electric charging machine which is under the control of the heater at all times. The pair furnaces are built double, that is, with one common binding between each furnace and each furnace is entirely independent of the one adjacent. Independent combustion chambers are used and independent stacks are used. An electric crane travels the full length of the building from the rear of these furnaces, thus eliminating all overhead travel on standing, which is customary in other

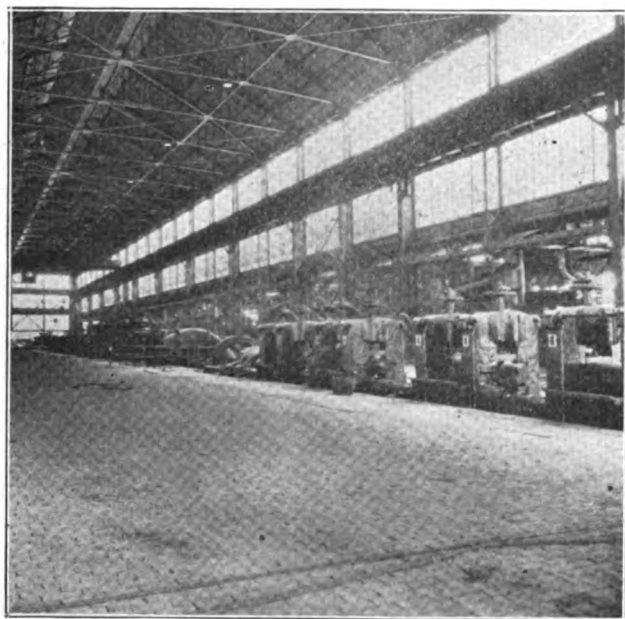


Fig. 4—General view of sheet and pair furnaces, charging side—in bar storage building.

mills. The cut bars are all handled by the crane at the rear of these furnaces and stacked adjacent to the charging machine. When charging these furnaces, the

operators are not exposed to any direct radiant heat as the doors are never opened until after the charging machine has been stacked with bars. When the cold heat is ready to be charged, the rear door is opened and the push button control of the charger automatically charges the new heat into the furnace and advances the next heat forward to the front of the furnace ready for rolling. By this particular type of furnace there is no extra handling of the bars such as is customary by piling in the old type furnaces. Each and every bar is advanced through the same heat zones, automatically heating the bars absolutely uniform and without scaling. This furnace was adopted for its superior qualities of heating and from the fact that tonnages can be maintained in the hot summer months the same as in winter months, due to the elimination of manual effort as the heater simply draws the bars from the furnace to the standing of hot mill. The pair furnaces are located within a few feet of the front line of the sheet furnaces and the drag of bars from furnace to hot mill is short, thus giving a superior working condition over those found in other plants as a rule. These pair furnaces are of the solid hearth con-

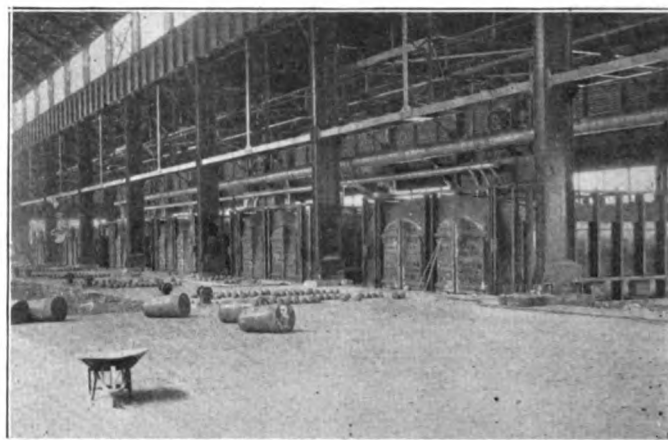


Fig. 5—View of annealing ovens in new sheet mill.

struction, having no return flues or circulation below hearth, thus assuring no loss of heat transmission, which is customary in the old type furnaces. The metallic hearths which are used in these furnaces are made by the Hagan Foundry Corporation, Orrville, Ohio, of special refractory or heat resisting iron. There are three double pair furnaces, designed for 12x50 in. maximum bars, thus allowing one pair furnace and one double sheet furnace for each mill. Six of the sheet furnaces have door clearance of 56 in. and two have door clearance of 62 in., which makes it possible to heat the maximum widths of sheets in these furnaces.

All furnaces are designed for maximum commercial tonnages that it is possible to turn out in sheet mill practice.

Fig. 5 gives a front view of the box annealing furnaces. These furnaces were all designed and constructed complete by the George J. Hagan Company, Pittsburgh, Pa. There are six double compartment, double length, annealing furnaces, giving ample spares and ample capacity for this plant. These furnaces are known as the heavy duty type furnaces. They are entirely bound with steel and castings, and are designed with extra heavy walls, which assures very low furnace loss. Each compartment of these furnaces is entirely independent of the compartment adjacent. The combustion chamber is independent and the control draft is independent. Thus,

one side of the furnace can be operating while the other side is idle. The balls and tracks of the annealing furnaces are made of Hagan refractory iron, furnished by the Hagan Foundry Corporation, Orrville, Ohio.

One of the most interesting features of this mill is the pulverized coal installation, which was supplied by the Quigley Furnace Specialties Company and provides powdered coal for sheet and pair and annealing furnaces.

The pulverizing plant is located about 100 ft. from the main buildings and at the extreme end of the annealing department building, which is located adjacent to and in line with the hot mill building. The pulverizing plant comprises a plate steel track hopper with reciprocating feeder attached to the discharge opening. The coal is delivered in hopper bottom cars to the track hopper, and after passing through a single roll coal crusher, is elevated by means of a chain and bucket elevator and delivered to a belt conveyor, equipped with magnetic separator pulley for the removal of any tramp iron. The coal is discharged into a 50-ton plate steel crushed coal bin, which is supported by structural steel framework above the firing end of the dryer. A regulating gate and worm feed screw control the feed of coal into a Ruggles-Coles dryer, having a capacity of 5 tons per hour. The coal on leaving the dryer is raised by a chain and bucket elevator and discharged into a 3-ton dried coal bin of plate steel. It is fed from this bin to a 5-roller low side Raymond mill, which pulverizes the coal and after finishing same removes the finished product by air suction, and deposits it into the powdered coal hopper of the compressed air transport unit. The hopper is supported by structural steel framework directly above a blow tank, which consists of a steel shell with suitable coal inlet valve, weighing scale, and compressed air controlled valves for admitting compressed air into the tank. A shut-off valve in the 4-in. transport line permits the

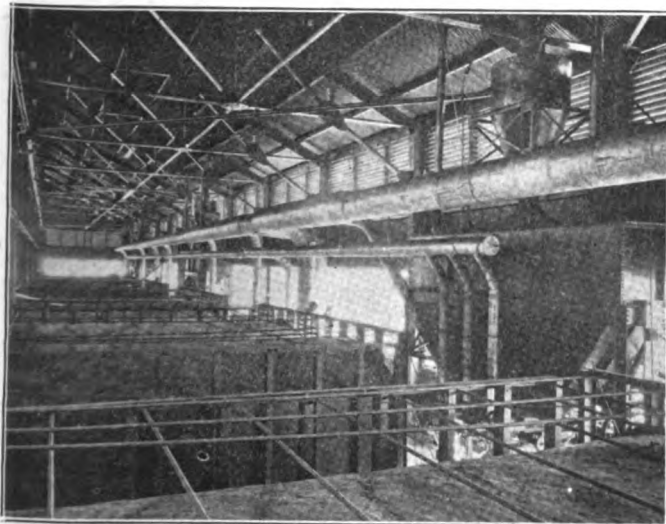


Fig. 6—View over top of annealing furnaces. In the right-hand foreground will be seen a powdered coal hopper, cyclone collector and transport line, together with the vent pipes to the outside of the building. The primary and secondary blast lines are clearly shown.

building up of pressure in the blowing tank to the necessary pressure for delivering the coal to any point desired in the mill. A single stage air compressor, motor driven, with suitable air receiver, etc., is included in the equipment to supply the compressed air for the transporting of the coal. The 4-in. transport line on leaving the milling plant crosses over, as is shown by the photo-

graph, to the annealing department. Three powdered coal hoppers retain the necessary powdered coal to supply the furnaces. To the bottom of these hoppers are attached four powdered coal feeders, all driven in multiple by one motor. Each annealing furnace has but one burner for each chamber, and the coal is fed by an individual feeder through a small wrought pipe at about 6-oz.

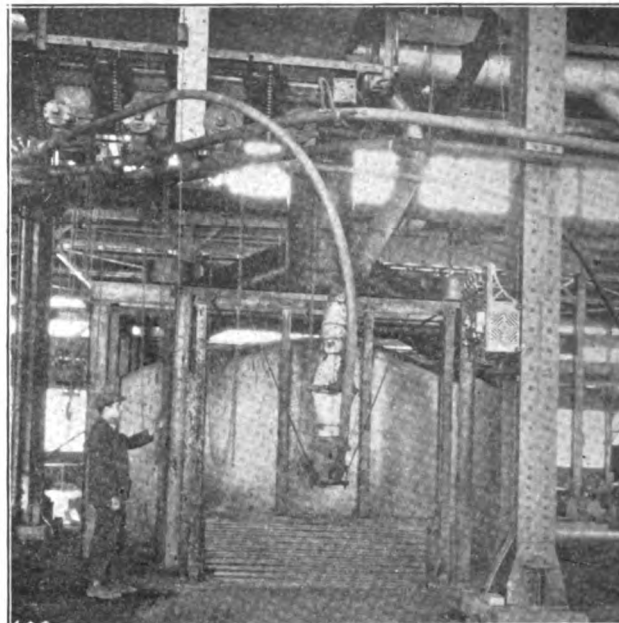


Fig. 7—Rear view of sheet mill furnace showing burner, coal and air pipes from feeders to burners, controllers attached to bottom of powdered coal hopper and etc.

air pressure, which delivers it to the combustion chamber of the furnace, through the center of the burner. The remainder of the air required for combustion is supplied by low pressure fans at about $1\frac{1}{4}$ -oz. pressure. The feeders are so arranged that all can be driven simultaneously or any one or more stopped. This is done by suitable clutch control mechanism. Switching valves of special design for the service are inserted in the 4-in. transport line, and divert the coal as required for the various powdered coal hoppers in this department as well as in the hot mills. A small Cyclone collector is provided on each bin for the venting of the small amount of compressed air used in the transport of coal. This absolutely eliminates the possibility of pressure being applied to the bins.

Upon leaving the annealing department, the coal transport line passes into the hot mill building, where it is supported from the crane girders.

A feature of this installation is the fact that throughout the annealing department and hot mill all equipment is operated from the mill floor.

The salient feature of the entire installation is its cleanliness. The milling plant is entirely free from powdered coal in suspension, and the same is true of the mill buildings. The building for housing the coal pulverizing equipment is of structural steel with corrugated iron siding and roofing, liberally supplied with windows and ventilation; the floor of this building is of concrete.

The hot mill standings on the furnace side of the mill are of the Baird water cooler type. These were furnished by the National Roll & Foundry Company.

There are five stands of cold rolls located in the an-

nealing building. These have 28-in. rolls. Two of the cold rolls and their drive, which were transferred from another section of the plant, were supplied by the Fawcus Machine Company, Pittsburgh. Three others, made by the Otis Company, make up the train. These are driven by a 200-hp. motor.

There are four 156-in. squaring shears located back of the finishing mills in the hot mill building. These shears, which are driven by 15-hp. motors, were supplied by the Erie Foundry Company of Erie. Located also in this building is a hydraulic snap bailer supplied by the Galland-Henning Manufacturing Company, Milwaukee.

The pickling department is equipped with two Mesta four arm steam operated automatic pickling machines. The Otis Company have designed and installed a special coke fired drying machine for drying high finished sheets after pickling. The operation of this machine is to pass the sheets between rubber rolls onto a motor operated conveyor that carries them on through the drying chamber, which is about 18 ft. long.

As stated before, the warehouse department is located in a large, well lighted building 380 ft. long and 75 ft. wide. Special equipment installed in this department consists of two Erie Foundry Company 156-in. squaring shears, two Walker & Elliot and a Hillis & Jones roller leveler, one Otis Company oiling machine, a Streine cor-

rugating machine, a Globe Foundry & Machine Company patent leveling and stretching machine, a painting machine, one Standard and one Fairbanks bundling scale and a Fairbanks beam registering scale. Sheets are hauled to the warehouse on roller bearing trucks built by the Ohio Galvanizing & Equipment Company by Lakewood Engineering tractors.

The crane equipment installed in the new plant consists of five Cleveland cranes ranging in size from 10-ton to 40-ton and one Alliance 40-ton crane. All the electric motors used in the plant outside of the two mill motors were furnished by the General Electric Company.

Throughout the entire designing and constructing of the plant, the safety and welfare of the workmen were provided for. All machinery was properly safeguarded when erected. Shower baths, lavatories, lockers and other modern conveniences will be provided for in a separate building that is to be constructed.

The construction of the plant, with the exception of the erection of the buildings and furnaces, was done by the Otis Company under the supervision of its mechanical and construction departments. The buildings were designed by the American Bridge Company in connection with the engineers of the Otis Company and were erected by the bridge company.

Developments in By-Product Coking

Prevention of Lime Deposits in Ammonia Stills—A New Plant Described Which Overcomes Many Difficulties Formerly Encountered, and in Addition Affords Excellent Heat Economy.

By A. THAU

PART I

THE ammonia liquor recovered on by-product plants holds the ammonia, outside of comparatively small amounts of free ammonia, in the form of salts in solution which, according to their inclination to decompose and liberate the ammonia, can be classed in three groups: First, salts which break up at normal temperature; second, salts which are decomposed by the influence of heat, and third, salts resisting high temperatures and decomposing only by chemical reactions under the influence of alkalies added. Corresponding with this behavior of the ammonia compounds in the liquor, the stills consist of three different parts, viz., one in which the free ammonia and the salts mentioned under 1 and 2 are subjected to high temperature, and the ammonia together with the acids liberated are at the same time expelled. The acids volatilized consist principally of carbon dioxide, sulphuretted hydrogen and hydrocyanic acid.

The liquor freed from the easily volatilized ammonia compounds retains only those salts in solution which are mentioned as the third group to decompose under the influence of alkalies. The liquor runs from the upper part of the still into a chamber in which it is mixed with milk of lime and overflowing from this chamber, the liquor holds only free ammonia in solution which is driven off by the heat in the third part of the still. Very few American plants and none in Europe apply soda lye in-

stead of lime, as the former, though much cleaner in operation, is generally too expensive for the purpose.

The operating of an ammonia still is under certain circumstances an expensive and uncertain operation because of the fact that by lime deposits and obstructing an inner passage for the liquor, the whole still may be suddenly thrown out of work. The reasons for the depositing of solid lime inside the still are two fold and must be attributed to either a mechanical cause or a chemical action, generally to both.

The treatment of the lime before being introduced into the lime chamber of the still varies in most plants. In the majority of cases the lime is slaked immediately with a great excess of water after its arrival, agitated with a scraper and passed through fine meshed screens into a large square pit in which the lime settles while the water drains gradually through the brickwork, so that the slaked lime remains in form of a thick paste which can be handled by a spade. In this condition it is according to requirements transferred to the stirrer tank of the lime feed pump and by means of a hose pipe quenched through a screen on top.

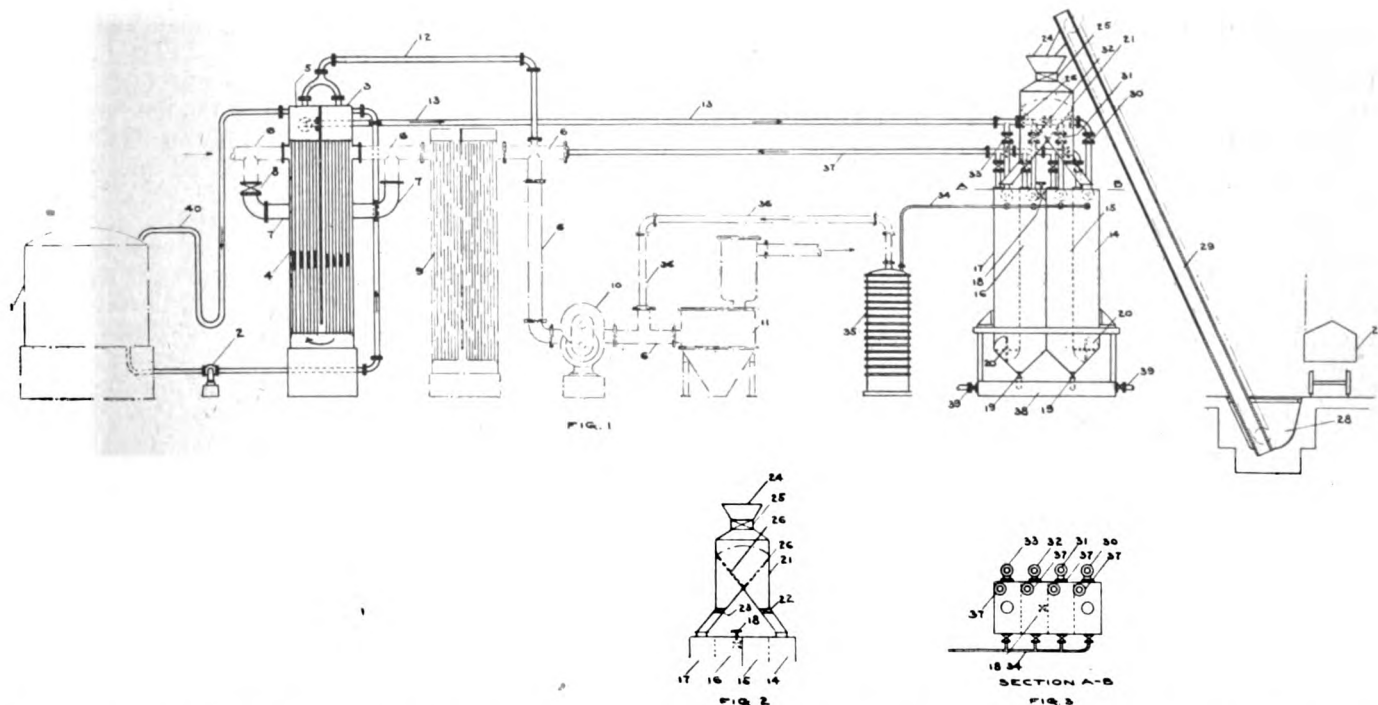
On other plants, particularly in England, the lime is not slaked in bulk, but stored in the same condition in which it arrives. A certain required amount is placed in a box screen which is partly submerged in the water

of the stirrer tank of the lime feed pump. The lime is so slaked and transformed into milk of lime without a preliminary treatment. Though these latter means of preparing the milk of lime may appear simpler and cheaper, it does not pay in the long run since calcined lime cannot for this purpose be stored any length of time in the open owing to its hygroscopic nature and because it deteriorates rapidly, losing much of its active properties. Such deteriorated lime will not dissolve to very fine particles and while the condition of the milk of lime should as near as possible approach that of a colloidal solution, the rough particles of the deteriorated lime have a tendency to settle out and deposit as soon as the velocity of the liquid increases. It does pay to take some pains in the preparation of the milk of lime in order to avoid trouble in the still, where poor lime causes obstructions.

The lime chamber of the still, in which milk of lime

soluble in water and very difficult to remove from the still, particularly if other mechanical impurities such as solid lime particles and pitch form a mixture with them. Though tar and lime have no inclination to enter into mechanical combination, the light oils of the tar are evaporated in the still and a soft pitch remains which, covering the bottoms of the still sections and taking a coat of solid lime on top, forms an effective isolating medium preventing the heat from penetrating the iron plate of the bottoms.

To prevent the lime from depositing inside the stills, a number of precautions should be carefully observed. The liquor should be free from mechanical impurities, particularly from tar. The feed and the steam admitted should be in such proportion that the free acids are completely driven off in the top sections and do not enter the lime chamber to form insoluble compounds. The milk



and ammonia liquor are mixed and brought in intimate contact with each other, is generally of great capacity and though steam is blown into it through a rose or perforated coil from the bottom, an even agitation over its whole area cannot be produced and some solid lime is sure to settle out on the sides and the bottom, particularly during the time the still is not operated. It is difficult to maintain the milk of lime at an even density and feed in exact requirements to the volume of the liquor. To be on the safe side, the stills are generally worked so that a small excess of solid lime is noticeable in the waste liquor leaving the still. If the density of the milk of lime is too great, or the feed too strong, an excess of solid lime will settle out in the third part of the still. This leads to a reduced efficiency and eventually to obstructions, throwing the still out of work altogether.

While this explains the mechanical depositing of solid lime, chemical reactions cause the formation of insoluble lime compounds if the already mentioned volatile acids are not driven off with the free ammonia in the first part of the still. With carbon dioxide the lime forms calcium carbonate, with sulphuretted hydrogen, calcium sulphate (gypsum) and with hydrocyanic acid, calcium cyanide, of which compounds the former two are not

of lime should be free from solid lumps and of proper density. If too thick, solid particles will settle out easily; if too thin a great waste of steam must be accounted for to heat the correspondingly greater amounts of milk of lime to the boiling point.

In the designs of the stills efforts are made to enable an easy cleaning of the stills or to prevent the depositing of solid lime altogether. A new still has recently been introduced in which every tray can be drained from time to time by means of valves accessible from outside for the purpose of cleaning the trays.

Still more effective are stills with revolving trays inside. They are built similar to the centrifugal gas washers, but rotate quite slowly to prevent solid lime from settling. There are two sets of trays arranged alternatively, one fixed to a vertical central shaft and revolving with it, the liquor overflowing on the periphery of the trays. The intermediate trays are fixed on their periphery to the inner shell of the still while the overflow of each is arranged in its center, allowing the shaft to pass through it. A great number of such trays give in this way the down flowing liquor mixed with milk of lime and the rising steam a long passage in zigzag way and counter current through the still. To prevent solid lime from depositing on the inner surfaces of the still, a num-

ber of steel scrapers are arranged inside in such a manner that the rotating trays are passing between fixed scrapers while the fixed trays and the inner shell of the column are kept clean by scrapers fixed to the central shaft and rotating with it. The shell is provided with hand holes through which the scrapers can be adjusted or exchanged. A number of such stills have made their appearance in ammonia works of German coking plants in recent years and are giving satisfaction because a periodical cleaning is not required now. Their upkeep and power consumption are naturally somewhat higher than with the ordinary stationary still while the units are also larger for a given output.

A new plant* has recently been tried on a small scale eliminating all the aforementioned difficulties and after various alterations, which are embodied in the sketches shown, giving entire satisfaction. Fig. 1 shows diagrammatically a typical by-product plant with the new arrangement included. The apparatus of the plant is only taken into consideration as far as the ammonia recovery is concerned and only that apparatus which serves the present arrangement are drawn in full lines, the other parts shown in dotted lines, are only added to make the whole plant easier understood. Figs. 2 and 3 are detail views of the plant.

The crude ammonia liquor collected at the by-product plant is decanted from the tar and stored in tank (1). From this it is drawn by means of the pump (2) and forced into the compartment (3) of a high level tank resting upon a heat exchanger (4). The latter is shown as an ordinary gas cooler with vertical tubes which in this case must be made entirely of cast iron. For this reason it might be more convenient to use a cooler with a great plurality of horizontal tubes which are shorter and easier to handle in erecting and can be made with thinner walls. In a heat exchanger as shown in Fig. 1 the liquor runs downwards from the compartment (3) through the vertical tubes directly underneath and passing through a bottom chamber travels upwards through the tubes of the other half, entering the compartment (5) of the high level tank.

The crude gas leaving the collecting main on top of the ovens enters the plant through a short main (6) and is conducted through the space around the tubes in the heat exchanger (4) in the opposite direction to the liquor, traveling through the tubes. The effect thus produced results in a partial cooling of the gas and a heating of the ammonia liquor. To be able to adjust the effect of the heat exchanger (4), corresponding to the heat requirements of the liquor, it is provided with a by-pass pipe (7) with valve (8) so that by regulating with the latter, a greater or smaller volume of raw gas can be conducted through the heat exchanger (4) or diverted from it, thus enabling the maintenance of a certain desired temperature.

On its further path through the plant, the gas is finally cooled, indicated by the cooler (9), propelled through the plant by the exhaustor (70) and passed through acid in the saturator (1)) to recover its vaporized ammonia.

In the heat exchanger (4), the part of the ammonia compounds which can be split under the influence of higher temperatures are decomposed by heat, and free ammonia together with acids like CO_2 and H_2S are liberated. This mixture of vapors collects in the upper part of the compartments (3 and 5) which is not occupied by liquor. The vapors are drawn through the con-

necting pipe (12) into the gas main (6) after the gas coolers.

The ammonia liquor thus freed from the easily volatilized acids, as well as from the greater part of the ammonia holds, now hold those compounds in solution which must be decomposed by chemical reactions under the influence of alkalies. For this purpose the liquor runs from the compartment (5) by gravity through the pipe line (13) into the decomposing tank.

The latter consists of four vertical chambers (14, 15, 16 and 17) which are separated from each other by means of partition walls, being at the same time interconnected in that the partition between the chambers (14 and 15) and the one between the chambers (16 and 17) does not reach quite down to the bottom while the middle partition between the compartment (15 and 16) is provided with a gate valve (18) immediately under the lid of the tank. Both halves of the decomposer are tapered funnel-like at the bottom and their bottom mouth pieces receive each a sludge valve (19). Above the tapered bottom is arranged in the compartments (14 and 17) a grate (20), fixed on to a central shaft which rests in two external glands and can be turned in the latter so that the grate can be brought into a vertical or horizontal position.

The top of the decomposer carries a lime hopper (21) which by means of a pipe shoot with valve (22) is connected to the top of the chamber (14) and in identical manner with valve (23) to the chamber (17). The lime hopper (21) is shown separately in Fig. 2 and opens on top in a funnel (24) under which a hopper valve (25) is arranged. Inside the lime bin (21) a hopper plate (26) is provided which can be swung from one side to the other by means of a shaft. The respective position of the hopper plate (26) depends upon whether the chamber (14) by means of valve (22) or the chamber (17) by means of the valve (23) are to be fed with lime.

The lime arrives in cars (27) which are emptied into the storage pit (28). From the latter the lime is conveyed according to requirements by means of a skip hoist or an elevator (29) to the top and dumped through the funnel (24) and valve (25) into the bin (21). A suitable amount of lime is drawn from the bin (21) through the valve (22) into the chamber (14) wherein it drops on to the grate (20), having been previously set to horizontal position.

The ammonia liquor pipe line (13) between the decomposer and the high level tank (5) is connected to each of the four chambers (14-17) by means of a valve (30, 31, 32 and 33 respectively) as shown in Fig. 3. If the valve (30) of the chamber (14) be opened, the decomposer will be filled completely by gravity with the liquor. It travels through the chamber (14) downwards, passes through the lime resting on the grid (20) and forming in dissolving an alkaline zone in the compartment, and ascends again in chamber (17), the grate (20) of which is turned to vertical position. On this long way of travel the ammonia compounds are decomposed by passing through an alkaline zone and any undissolved particles of lime have settled down and the clear liquor which now holds only free ammonia in solution leaves the chamber (17) by the pipe (34) entering the ammonia still (35). The ammonia driven off in the still (35) by steam is conducted through the pipe line (36) connected to the gas main (6) before the saturator (11) or the vapor may be conducted directly into the saturator, depending upon the recovery principle applied to the by-product plant in general.

*Patent applied for.

The overflow pipe (34) of the decomposer is by means of a valve each connected with the chamber (14, 15, 16 and 17 respectively) to be able to take, if necessary, the liquor from either of the four chambers. This arrangement is better shown in Fig. 3. As in the decomposing of the ammonia salts so high a vapor tension is created that part of the ammonia is liberated as vapor, every compartment of the decomposer is connected from the lid by means of a cock each to the pipe line (37) and the latter is connected to the gas main before the exhauster (6) so that any vapors developed are drawn off and mixed with the gas.

As the liquor leaving the chamber (14) around the partition near the bottom holds still a certain amount of active lime in solution, the valves (31, 32 and 33) are so adjusted that also the chamber (15, 16 and 17) receive a small feed of ammonia liquor from the pipe line (13) in order to utilize the active lime without loss.

After a certain period of working, so much insoluble impurities of the lime will settle down in the bottom of the chamber (14) that the apparatus must be cleaned. To do this without interrupting the working of the still, the way of circulation through the decomposer is reversed by means of corresponding adjustments of the valves. The lime is then, by opening the valve (23) and reversing of the hopper plate (26) fed into the chamber (17), the grate (20) of which has been brought into horizontal position. While the flow through the chambers (14 and 15) is stopped, the liquor runs from the chamber (16) direct to the still.

To clean the chambers (14 and 15), all valves on top of these two chambers are closed and the bottom valve (17) is opened so that the contents run out with the lime sludge into the collecting basin (38) underneath. The sludge settles at the bottom and is washed with water after the ammonia liquor is decanted off through the valves (39) into the accumulating tank of the by-product plant. After the sludge has again settled, the water is decanted off the same way and the lime residue can be shoveled out from the bottom of basin (38).

Immediately after the chambers (14 and 15) have been cleaned—generally they need only be sludged by opening the bottom valves (19) for a short time without emptying the compartments—they can be taken into the liquor circuit again by opening the valve (18) so that the liquor travels then in opposite direction through the decomposer. The grate (20) in the chamber (14) is then set vertically and the liquor leaves by the chamber (14) to enter the still (35). By these means the decomposer can be cleaned completely without interrupting the flow of the liquor or the operating of the still.

Depending upon the amount of heat applied to the liquor in the heat exchanger (4), the original volume of ammonia liquor may be reduced by 50 per cent and as the remainder enters the still as a clear and more or less preheated liquid, the consumption of steam for distilling is reduced considerably, a cleaning of the still is no more necessary, the amount of obnoxious effluent liquor is reduced proportionately and a comparatively very small single column apparatus serves as ammonia still.

To prevent the ammonia liquor in case of obstructions or erroneously closed valves to overflow from the high level tanks (3 and 5) through the pipe line (12) into the gas main (6), the top of the tank (5) is provided with an overflow pipe (40) in the shape of a siphon and connected to the liquor store tank (1).

On plants not recovering the ammonia by the direct process like on independent ammonia plants or on gas

works on which the vapors from the heat exchanger and decomposer cannot be returned into the gas main, they are conducted into a saturator to retain the ammonia while as a heating medium for the heat exchanger the foul vapors from the saturators can be utilized and condensed so that only the small uncondensable volume need be absorbed in purifiers.

The advantages offered by this plant are too obvious to call for further comment, attention may only be called to the excellent heat economy by utilizing sources of heat which are otherwise wasted and even employing the heat created by the reaction between the lime and ammonia compounds, while no matter is added to the process for slaking and diluting the lime, saving a corresponding expenditure of steam.

ENGINEERS SOCIETY OF WESTERN PENNSYLVANIA HOLD BANQUET.

The forty-third annual banquet of the Engineers Society of Western Pennsylvania was held at the William Penn Hotel the evening of January 23rd and was attended by approximately 600 members. G. S. Davidson, President of the Gulf Refining Company acted in the capacity of toast master, while Henry D. James, President of the Engineers Society presided. The speakers of the evening included Governor H. J. Allen of Kansas, E. A. S. Clark, President of the Consolidated Steel Corporation, New York, and E. J. Cattell, statistician of Philadelphia.

In discussing the "Responsibility of the State for Industrial Relations," Governor Allen described the Kansas industrial relations court and stated that in the two years of its life, 38 out of 40 cases brought before it, have been settled amicably and acceptable to both capital and labor. He said he is not opposed to labor unions and pointed out that 75 per cent of the court's decisions were in favor of labor notwithstanding the fact that all opposition against it had originated with labor leaders, 150,000 of whom draw annually approximately \$60,000,000 from the pockets of American workmen. Stating that progress of humanity has been due to betterments of labor and labor conditions, Governor Allen said:

"No peace can exist between employees and employers until an honest day's work brings an honest day's pay and an honest day's pay brings an honest day's work. This cannot be brought about so long as labor secretaries of war, its so-called leaders, are the controlling factors. The state has the right to protect the public against strikes and the Kansas law has been written upon the old principle that the safety of the public should be the supreme law. The Kansas industrial court does not take away the man's rights to quit work; but it holds that the right to work is as sacred as the right to loaf and that no combination of capital or of labor should be allowed to bring economic pressure to bear in an essential industry relating to food, fuel, clothing and transportation."

E. A. S. Clarke, president of the Consolidated Steel Corp., New York, read a paper upon "Foreign Trade." He stated that the whole world is one great market awaiting development and while at the present time there does not seem to be enough business from domestic sources to keep mills and men active, methods, financial and otherwise will be found to revive export trade so as to make it pay real dividends.

E. J. Cattell, statistician of Philadelphia, entertained with humorous anecdotes.

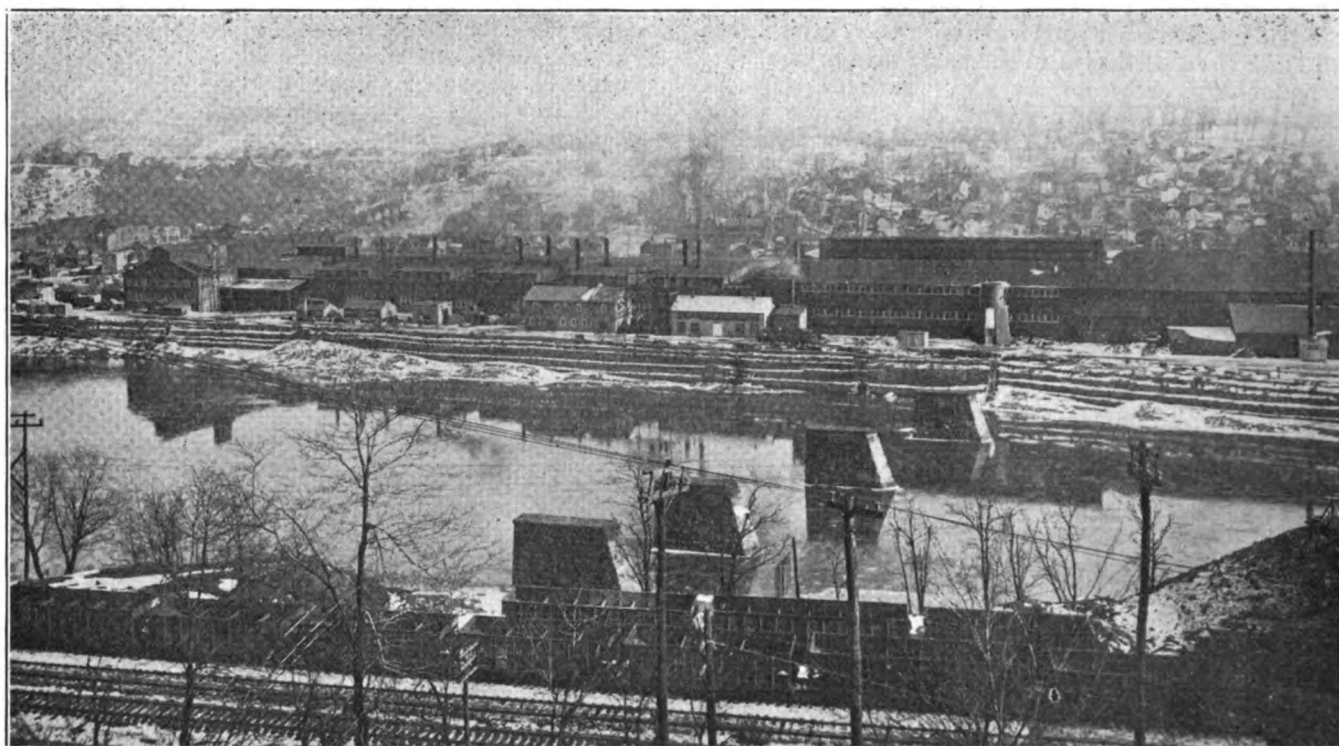


Fig. 1—Lower portion of the plant.

Apollo Steel Company Enlarge Plant by the Addition of a New Sheet Mill Unit

Two Jobbing Mills and Four Additional Sheet Mills Were Added to the Original Plant—Modern Improvements in Sheet Mill Construction Feature the New Additions.

THE Apollo Steel Company, located at Apollo, Pa., on the right bank of the Kiskiminetas river, have just completed an extension to their plant which will enable them to manufacture sheets in all gauges from 10 to 30, and widths up to 60 inches, and will contain also black plate mills for the manufacture of light gauges for export.

General Layout of Plant.

The original works of this company, which were built in 1912, consisted of six 28-in. sheet mills, with range in width from 24 in. to 40 in., with cold rolls, annealing furnaces, and a pickling and galvanizing plant. In 1918 two hot mills were added, making the plant an 8-mill unit. However, the trend of business required larger and heavier sheets than could be rolled on the 28-in. mills and plans were made to build two 32-in. jobbing mills and four additional sheet mills on adjoining land.

The general layout of the new plant as furnished by the United Engineering & Foundry Company was accepted. It was, however, modified considerably during construction. The actual construction began in May, 1920, when all building foundations were put in by the Mill Company. The delivery and erection of the build-

ings was greatly delayed by strikes and they were not under roof until January 1921. The buildings were manufactured by the Blaw-Knox Company.

The general view and layout of the plant shows how the prevailing thought in the construction of the new extension was to provide plenty of working space, light and ventilation, so that conditions for the workmen would be as near ideal as possible.

Buildings.

The furnace building has a width of 75 ft. The mill building proper is covered by a crane with a 68-ft. span. The shears and continuous annealing furnaces are housed in a 38-ft. wide building. These three buildings each have 15 bays at 24 ft. or are 360 ft. in length. They are provided with ventilating top hung steel sash in the roof, the full length of the buildings, and every other bay is arranged with lifting doors on the west, south and east. This gives the works the full benefit of fresh air currents coming from any special direction. The three box annealing furnaces are built in a lean-to 152 ft. long and 32 ft. wide which is alongside the annealing and pickling building. This building runs north to south and has a total length of 410 ft. by 72 ft. wide. The ventilation of the building has also been taken care of

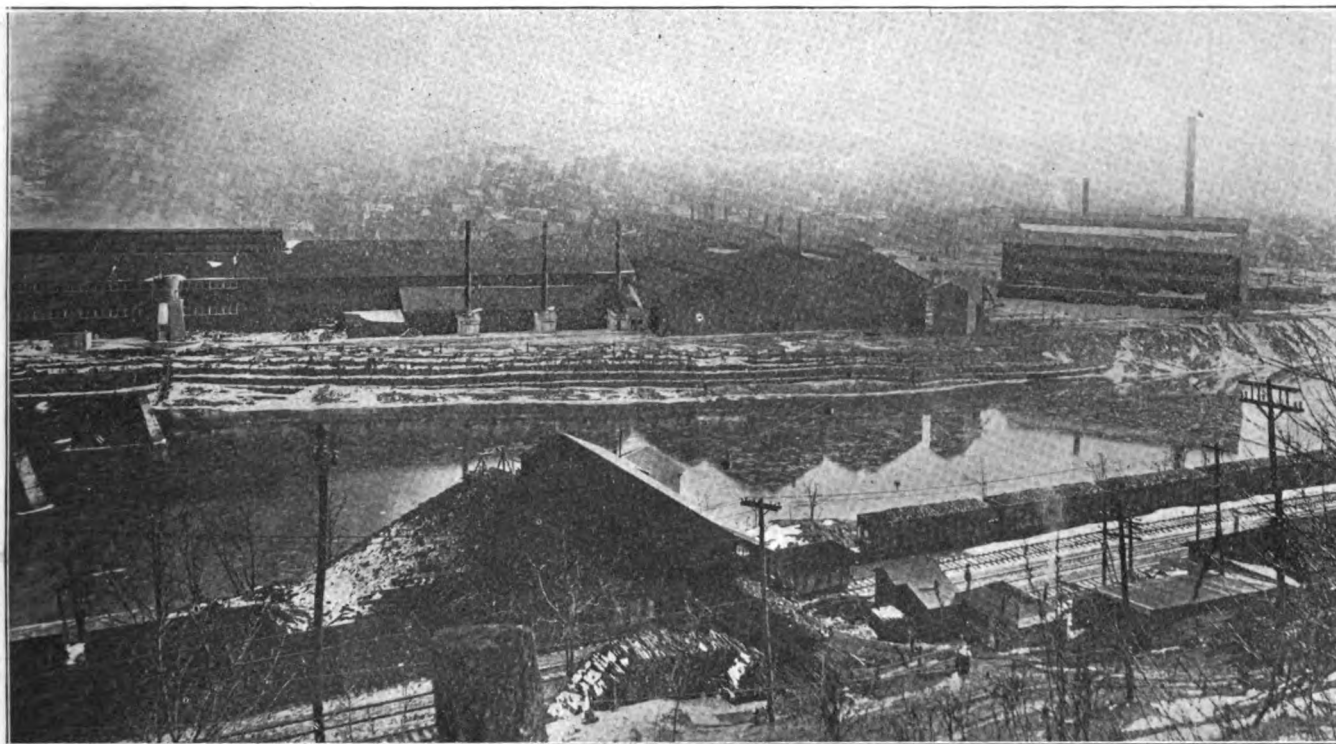


Fig. 2—Upper portion of the plant.

by continuous sash in the skylight and large doors that open on the river side.

The warehouse, which will take care of the products of both the old mill and the extension is a steel building with brick curtain walls and has a generous area of windows. In this connection it may also be stated that all the buildings have been provided with an artificial light system, by which large incandescent flood lights make the illumination by night as even and bright as by the natural daylight. The floors in all the buildings are of brick except in the warehouse, where steel plate runways are laid on concrete slabs, making trucking easy. The sanitary conveniences include three comfort stations built in accordance with latest standards. The drinking water cooling system is installed with distribution pipes encircling the whole plant.

Furnaces.

The furnace equipment, which was furnished by the Hagen Company, consists of four combination sheet and pair furnaces, two Costello continuous blue annealing furnaces and three double box annealing furnaces. All furnaces except the Costello furnaces are designed for coal firing with stokers, the drive for which on the sheet and pair furnaces and also the slab furnaces is underground in specially designed pits so that easy access to all machinery is available. The Costello furnaces are gas fired and are equipped with the Surface Combustion Company's gas mixer, regulator, and burners, it being the company's aim eventually to install gas in all furnaces.

Mills.

The mills and auxiliary equipment were furnished by the United Engineering & Foundry Company and is the last word in sheet and jobbing mills design. The housings are of exceptionally heavy construction and are made of cast steel. On the east side of the drive are the two 32-in. jobbing mills. These mills are two high mills 32 in. in diameter by 66 in. length of rolls. The rough-

ing mills are balanced and have a motor driven screw down, and are also provided with catchers lifting table. The finishing mills have a lifting table on the catchers side and the gap between these tables and the Costello furnaces is bridged by a set of casters.

A single stand of cold rolls acts as a drag on the end of the drain. To facilitate the delivery of hot slabs from the furnaces to the mills an overhead trolley track has been installed as shown on the photograph of the mill.

The west end of the train, consisting of two 32 in. by 54 in. finishing mills with common roughing stand and a cold roll stand, is connected to the drive through a turned steel shaft. These mills are equipped with not only doublers, but also with doublers shears for making light gauge black sheets. Two 156-in. squaring shears will take care of these four mills, and a 40-ton transfer car electrically operated will carry out all of the box annealing furnace building.

Drive.

The mills are driven by an 1,800-hp. General Electric Company motor running at 240 rpm. through an 8 to 1 reduction—herringbone gears. This drive is almost a copy of the drive for the old mill, installed in 1912. At this time this drive was the first of its kind installed, while now it is almost universally used on all sheet mills. The United Engineering & Foundry Company designed and built these drives. A complete Bowser oiling system takes care of all the bearings of the drive.

Sheet Mill Floors.

Realizing that cool floors are not only a great help to increased production, but also a modern convenience for the mill worker, and with water cooled floors out of the question on account of the water supply being acute, inasmuch as the river is strongly acid and only salt water can be secured from the wells sunk on the property, experiments were conducted with grate flooring in front of the finishing mills, and found efficient. Incidentally,

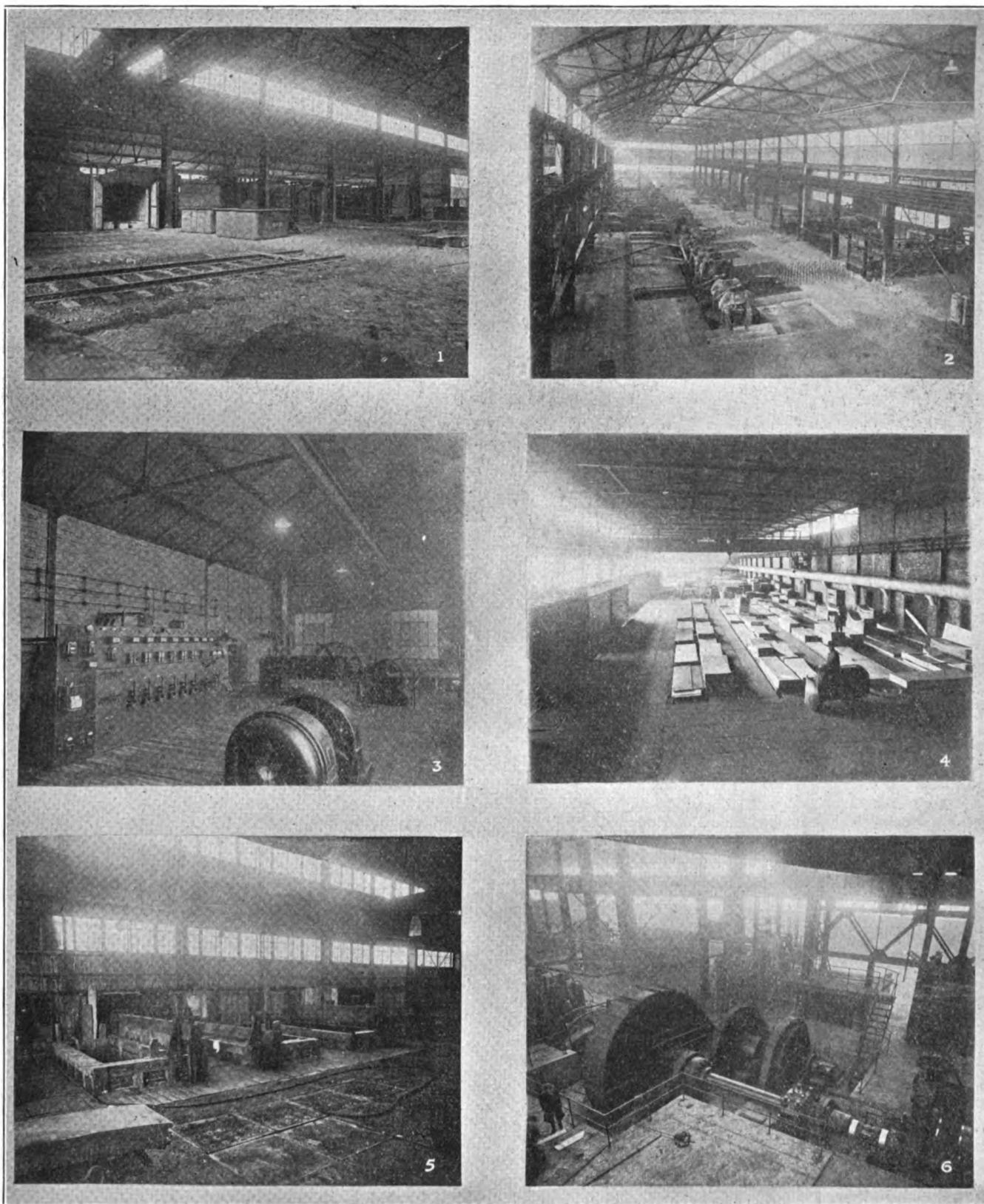


Fig. 1—View of Geo. J. Hagan Co. annealing furnaces.

Fig. 3—Interior view of power station. All electrical equipment in the plant was furnished by General Electric Co.

Fig. 5—View of the pickling department.

Fig. 2—View of hot mill department.

Fig. 4—Interior view of the new warehouse.

Fig. 6—General Electric Co. 1,800 hp motor which drives the mills.

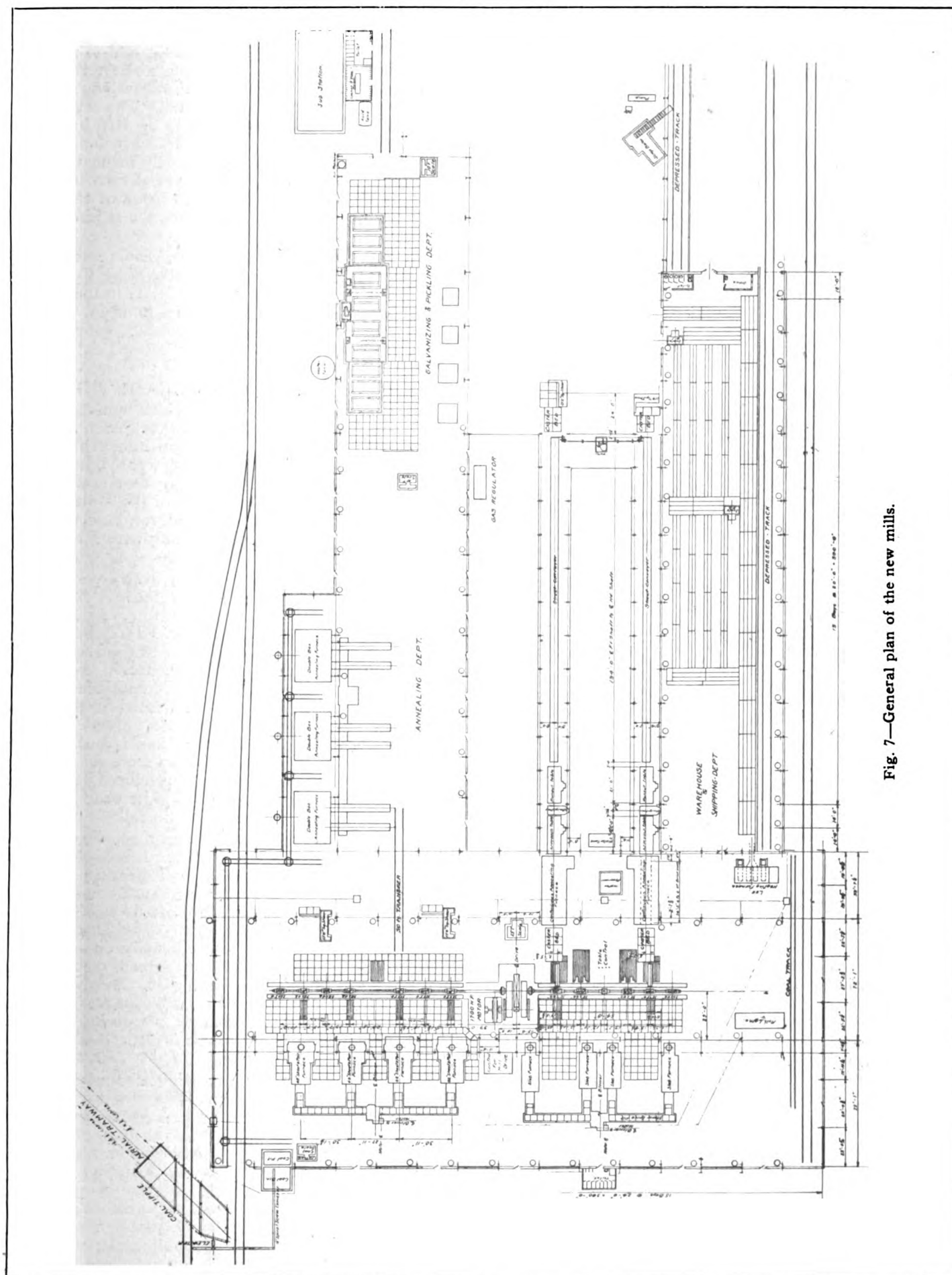


Fig. 7—General plan of the new mills.

a large saving in operating cost was made as a result of obviating the use of water. The grating is laid over an open air space about 18 in. deep and was demonstrated at the old mill to be satisfactory, as it remains cool in the hottest summer weather and is non-slipping.

Finishing.

The product from the two jobbing mills is moved mechanically through the Costello blue annealing furnaces to a set of tables, and then to a Newhold roller leveler, and then on another set of tables it is carried to a conveyor designed by the steel company and built by the Chain Belt Company. This conveyor, which is 165 ft. in length, takes the sheets to the shears, located in the upper end of the old mill building. Here the sheets are squared or stored for shipment.

The sheet mill product goes through the annealing furnaces to the black warehouse, or to the pickling tanks, of which four are built in two units driven by a common motor. These tanks are of the plunger type, and the complete equipment was designed by the company. The tanks were built by the mill shops, while the machinery was manufactured by the United Foundry & Machine Company, Canton, Ohio. The pit in which the tanks are placed is concrete, lined with bricks, with sulphur run in the joints. Provisions have been made for making possible the installation of the copperas plant later on. The original installation of four galvanizing pots has not been enlarged as yet, but plans have been made for two additional pots and a modern dryer.

The warehouse has, as the photograph shows, a depressed track, so that all loading and shipping is done indoors. The heating of this building is by hot air, the air being moved from the warehouse through the heating tubes of a Lee furnace and distributed in the warehouse by a Sturtevant fan. The B. F. Sturtevant Company furnished the induced draft fan, the distribution fan and the distribution pipes.

The power situation at this plant is unique, as all the current is purchased and no boiler equipment is used except a small heater for the pickle. General Electric Company furnished all the electric equipment used in the new additions.

The electric power is furnished by the West Penn Power Company and is stepped down from 22,000 to 2,200 volts at the transformers under transmission tower on the river bank. Both the 1,400-hp. motor for old installation and the 1,800-hp. for new mills use the 2,200-volt current set in substation used for furnishing d.c. for screw down and mill table motors.

The cranes in this extension are all Cleveland cranes, one 15-ton in the furnace building, a 30-ton with 10-ton auxiliary in annealing, and one 15-ton over the pickling and galvanizing department. The warehouse crane is a 15-ton crane.

For turning rolls, a 42-in. heavy duty enclosed Headstock type roll turning lathe, designed and built by United Engineering & Foundry Company, has been provided. A 36-in. Gridgeford engine lathe has been installed to take care of the heavier work in connection with the larger mill units.

Raw material can be delivered to the plant at either end of the mill building. Ample floor space in the furnace building has been provided for bars and slabs.

The coal supply is arranged for from a mine on the opposite bank of the Kiskiminetas river via aerial tramway to a 75-ton bin, under which a Jeffrey crusher is

located, crushing the coal, then elevating it. This elevator has delivery on the one side to a screw conveyor, on the other side the chute delivers the coal to a railroad car. The screw conveyor takes the coal direct to a bin with a pit in the front, so as to load coal boxes for delivery to the furnaces in the new mill. The coal dumped in the railroad car is transferred to the coal bin (under track) at the old mill, from which it is distributed to furnaces. It may be added that the only manual work on this side consists of noting the weight of each full bucket as it comes on the scales. The discharge of the buckets is done automatically, and the drive rope is running continuously.

The estimated output of this extension, combined with the original plant, gives the Apollo Steel Company a capacity of approximately 120,000 N. T. in the one pass cold rolled and galvanized sheets up to 48 in. wide, and blue annealed sheets up to 60 in. wide.

LIGNITE AS A HIGH GRADE FUEL.

Lignite, or "brown coal," which constitutes approximately one-third of the Nation's coal resources, can be converted by carbonization into a high grade fuel adapted to a wide range of purposes and limited only by its relative cost, according to a statement issued by Director H. Foster Bain of the United States Bureau of Mines. It cannot, however, be classed as a cheap fuel in the sense of competing with a high class, easily mined bituminous coal.

A lignite carbonizing plant has been erected by the University of North Dakota at Hebron, North Dakota, in a field whose lignites are similar to those found in the Nenana field in Alaska. Dr. E. J. Babcock, dean of the engineering department of the university, has been for years directing experiments in carbonizing and briquetting lignite and has made notable progress.

During the past summer, the United States Bureau of Mines has cooperated with the university in the operation of the plant, and more than a thousand tons of raw lignite have been treated and more than 400 tons of lignite char briquettes were produced, this being probably the largest amount of lignite char briquettes that has ever been made at one time.

By removing the moisture and a considerable portion of the volatile matter from the raw lignite, a char can be obtained which possesses a heating value and chemical analysis quite similar to anthracite coal. In this process, a ton of raw lignite will yield forty per cent of high grade lignite char. The physical form of this char is such that approximately one-third of it will go through a one-eighth inch screen, the remainder up to pieces the size of shelled corn. By the addition of eight to ten per cent of suitable binding material, excellent briquettes can be made, whose heating value and availability for general use is little less than that of Pennsylvania anthracite.

The fixed carbon in these briquettes may run from 72 to 81 per cent, as compared with that of 35 per cent in raw lignite. This makes it practicable to transport the fuel to much greater distances than would be practicable with raw lignite. The briquettes are pillow-shaped, weighing about two and a half ounces each. When produced with suitable skill, the briquettes will stand handling, transportation and weather conditions in storage. The product is a stable one, thus removing the greatest limitation to the usefulness of the original lignite.

Graphical Treatment of Stack Gas Analysis and of Producer Gas Analysis

Graphical Representation of Producer Gas Analysis—Review of Graphic Charts as Introduced by W. Ostwald.

By W. TRINKS

PART II

ON pages 44 to 57 of his book on "Graphics of Combustion Engineering," Mr. Ostwald takes up the gasification of carbon. Upon Ostwald's work as a foundation, Claus & Neussel have built a rather complete theory of the gasification process (Z. d. V. D. I., No. 29, of 1921). The following derivations follow the same reasoning as these two publications, using, however, a shorter and more direct method for the construction of the principal diagram.

Gasification in the producer takes place in three stages, which are drying, distillation of volatile matter, and gasification of carbon. In consequence, producer gas contains water vapor, products of distillation, and products of gasification. In the analysis of producer gas, as it is commonly made, water vapor as well as all condensable tar vapors do not appear, but ethylene, methane, CO, CO₂, H₂, and N₂ are found. Ethylene and methane are not products of gasification of carbon, but of distillation, which means that gasification of carbon produces only CO, CO₂, and H₂, with N₂ as a diluting gas. As far as gasification is concerned, the quality of the producer gas depends solely upon the percentages of CO, CO₂, and H₂, or,

being used in a graphical representation. For the latter he uses Gibbs' equilateral triangle, see Fig. 1, to the three corners of which correspond the following equations:

- $C + O_2 = CO_2 + 97.6$
- $C + 2H_2O = CO_2 + 2H_2 - 18.8$
- $C + CO_2 = 2CO - 38.8$

In these equations the symbols represent metric mols (gram-molecules) while the figures are gram-calories. The equations can be converted into pound molecules by multiplication of the figures by $\frac{1,000}{2.2}$

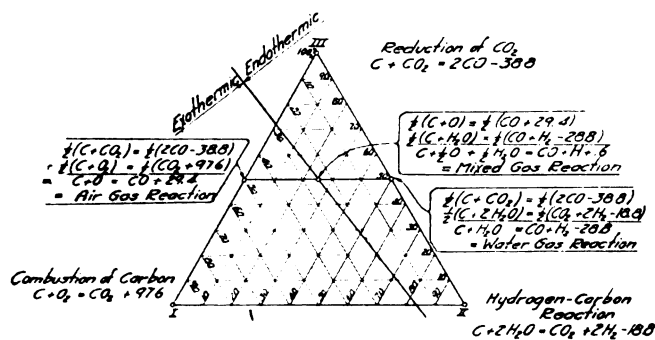


Fig. 1.

in other words, in the gasification zone of every producer, coke is gasified, no matter what the nature of the original coal might have been when charged. For this reason, the theory concerns itself at first only with the gasification of pure carbon.

The process of gasification of pure carbon by air and steam cannot be expressed in a single equation, but yet there corresponds to each gas analysis only one combination of the various equations, and it is wholly immaterial from a thermochemical standpoint through what intermediate steps the final composition of the gas has been reached.

From the eight reaction equations, Ostwald selected three which lend themselves most readily to

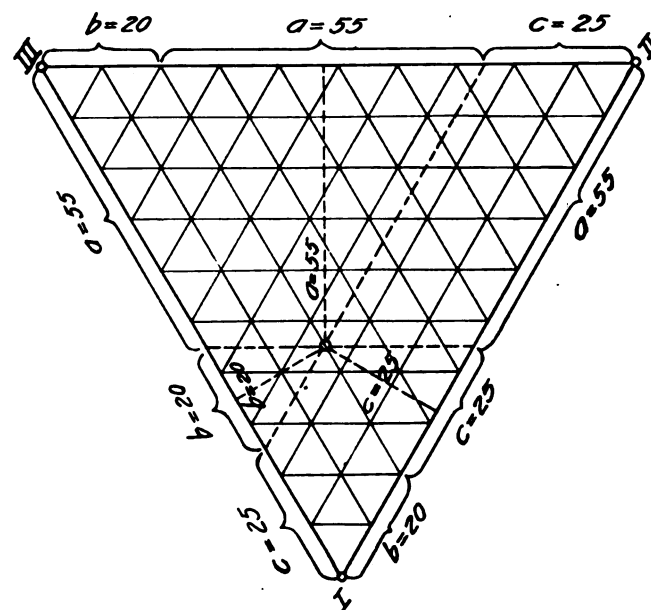


Fig. 2.

$\times 2.2 \times 1.8$, because one pound = 1,000/2.2 grams, and a kilogram calorie = 2.2×1.8 Btu. It may also be remarked that a metric mol of carbon = 12 grams.

In the illustration, Fig. 1, the reactions for, and the significance of some of the more important points of the triangle are given in detail.

Further information on the properties of the gasification triangle can be gained by addition of the equations a), b), and c). The result is $(a + b + c)C + aO_2 + 2bH_2O + cCO_2 = (a + b)CO_2 + 2bH_2 + 2cCO + 97.6a - 18.8b - 38.8c$. This means that, of $(a + b + c)$ parts of carbon, a parts react as in equation a), b parts react as in equation b), and c parts as in equation c). Rearrangement of the terms fur-

nishes $(a + b + c) C + aO_2 + 2bH_2O = (a + b - c) CO_2 + 2bH_2 + 2cCO + 97.6a - 18.8b - 38.8c$.

If the length of each side in the triangle equals 1, then $a + b + c = 1$; but if the length of that side equals 100, then $a + b + c = 100$. This latter figure was used in Fig. 2, in which $a = 55$, $b = 20$, and $c = 25$. If dilution nitrogen is added, then $100 C + 55 O_2 +$

$$55 \times \frac{15N_2}{4} + 40 H_2O = 50 CO + 40 H_2 + 50 CO + 55 \times \frac{15}{4} N_2 + 4034.$$

The right hand member of the equation corresponds to a gas analysis of 14.4 per cent CO_2 , 14.4 per cent CO , 11.5 per cent H_2 and 59.7 per cent N_2 . This is a very poor gas, but it will do for an example.

The figure in the right hand member indicates the

tions of the carbon gasified according to each of equations a), b), and c). For any reaction corresponding to a point in the triangle, it is possible to calculate the CO_2 , CO , and H_2 contents from these equations, taking care to include, of course, the dilution nitrogen which enters with the oxygen. But the attempt to reverse the process, and to locate a point in the triangle corresponding to a gas composition, either assumed or determined by analysis, meets with difficulties; for, while in the first procedure, any values of a , b , and c may be taken, as long as $a + b + c = 1$, in the reverse process the sum of $(CO_2 + CO + H_2)$ is not equal to unity, or to any constant sum.

It is evident, then, that a very desirable addition would be a network of lines of constant CO , H_2 , and CO_2 spread over the triangle. In the article referred to above, Clause and Neussel construct such a network by means of the detour of a proportion-triangle

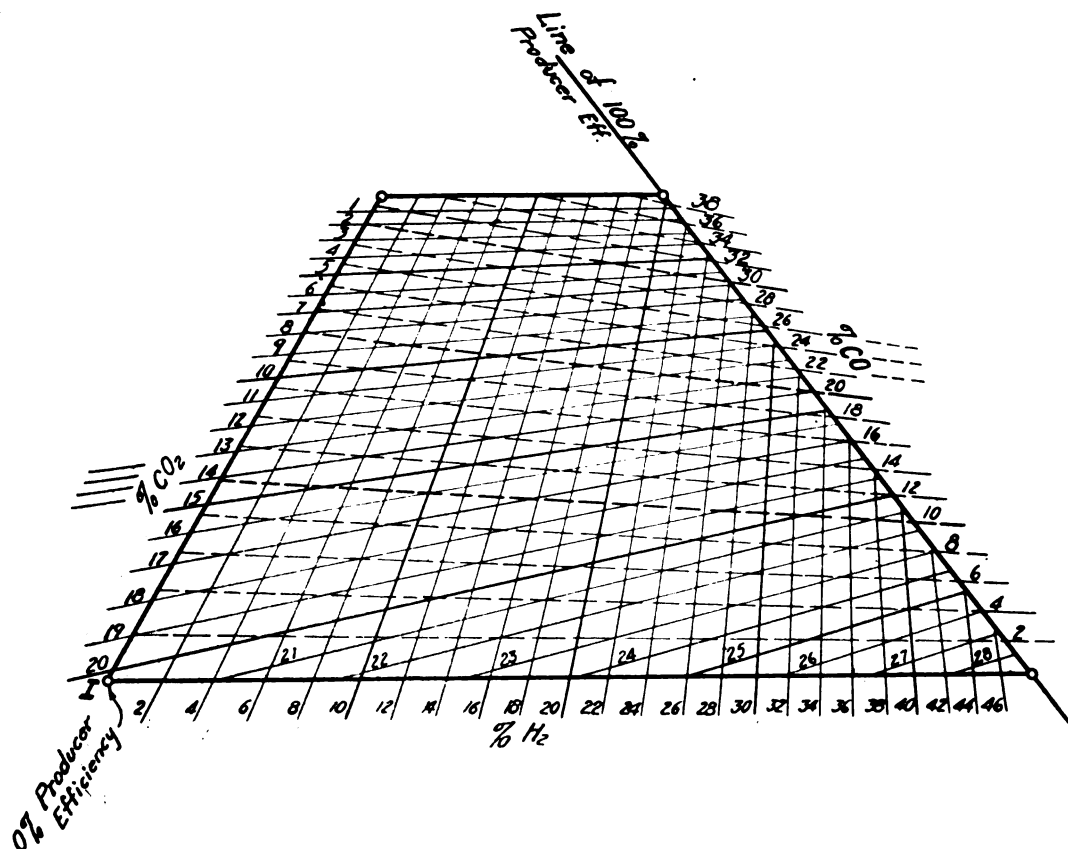


Fig. 3.

heat which is liberated by the reaction. If the figure is negative, heat from an outside source is required for the reaction. The line which crosses the triangle in Fig. 1, from the upper left hand corner to the lower right hand corner, separates the endothermic from the exothermic field. That line follows those reactions which neither liberate nor use up heat. It has been called the "neutro-caloric" line by Ostwald. For all practical producer gas work, reactions which require heat from an outside source need not be considered, and in consequence, the right hand strip can be eliminated from the triangle, see Fig. 1. Of the remaining triangle, the top can be eliminated, because, in the top section, addition of CO_2 from an outside source is required, and such addition is not used in ordinary producer practice.

So far, the chart shows only the possible propor-

with lines of constant ratios $\frac{CO_2}{H_2}$, $\frac{CO_2}{CO}$, $\frac{H_2}{CO}$. The chart which they derive thereby is shown in Fig. 3. It includes a correction for methane content, as will be explained later. The chart applies to coals having a very large amount of volatile matter, but does not consider the addition of hydrogen from breaking up of the heavy distillates due to heat. The network of lines of constant CO_2 , CO , and H_2 can, however, be located directly, as in the following original derivation:*

Pure carbon is first considered, and is regarded as being in the gaseous form when the reaction occurs. (See article in January issue.) Repeating equations a), b), and c) in slightly different form, we find

*This derivation was made by J. D. Keller, mechanical engineer with Prof. Trinks.

- a) $C_2 + 2 O_2 = 2 CO_2$
 b) $C_2 + 4 H_2O = 2 CO_2 + 4 H_2$
 c) $C_2 + 2 CO_2 = 4 CO$

Of one (equivalent) cubic foot of C_2 ,

- a cu. ft. reacting as in equation a), require **2 a** cu. ft. of O_2 and produce **2 a** cu. ft. CO_2 .
 b cu. ft. reacting as in equation b), require **4 b** cu. ft. H_2O (vapor) and produce **2 b** cu. ft. CO_2 and **4 b** cu. ft. H_2 .

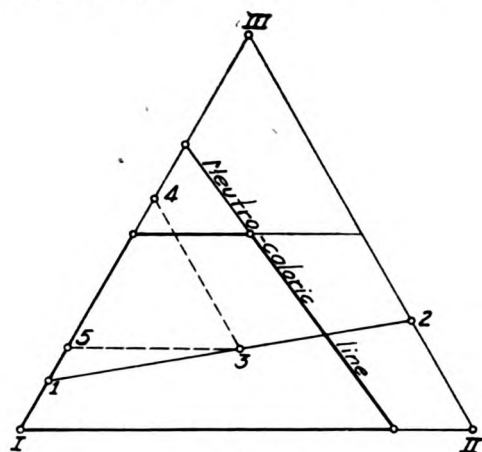


Fig. 4.

- c cu. ft. reacting as in equation c), require **2 c** cu. ft. CO_2 and produce **4 c** cu. ft. CO .
 a, b and c in this case represent fractions of one cubic foot.

Total volume of CO_2 produced = $(2a + 2b - 2c)$.
 Total volume of CO produced = $4c$.
 Total volume of H_2 produced = $4b$.

Since with 1 cu. ft. of oxygen from the air, there are associated $\frac{79}{21}$ or (very closely) $\frac{15}{4}$ cu. ft. of nitrogen, the total volume of N_2 included = $\frac{15}{4} \times 2a = \frac{15}{2} a$.

As no excess air can exist in producer operation, no free oxygen is present.

A summing up furnishes the total volume of gases

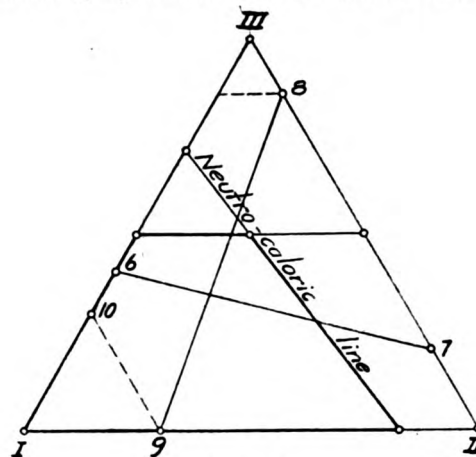
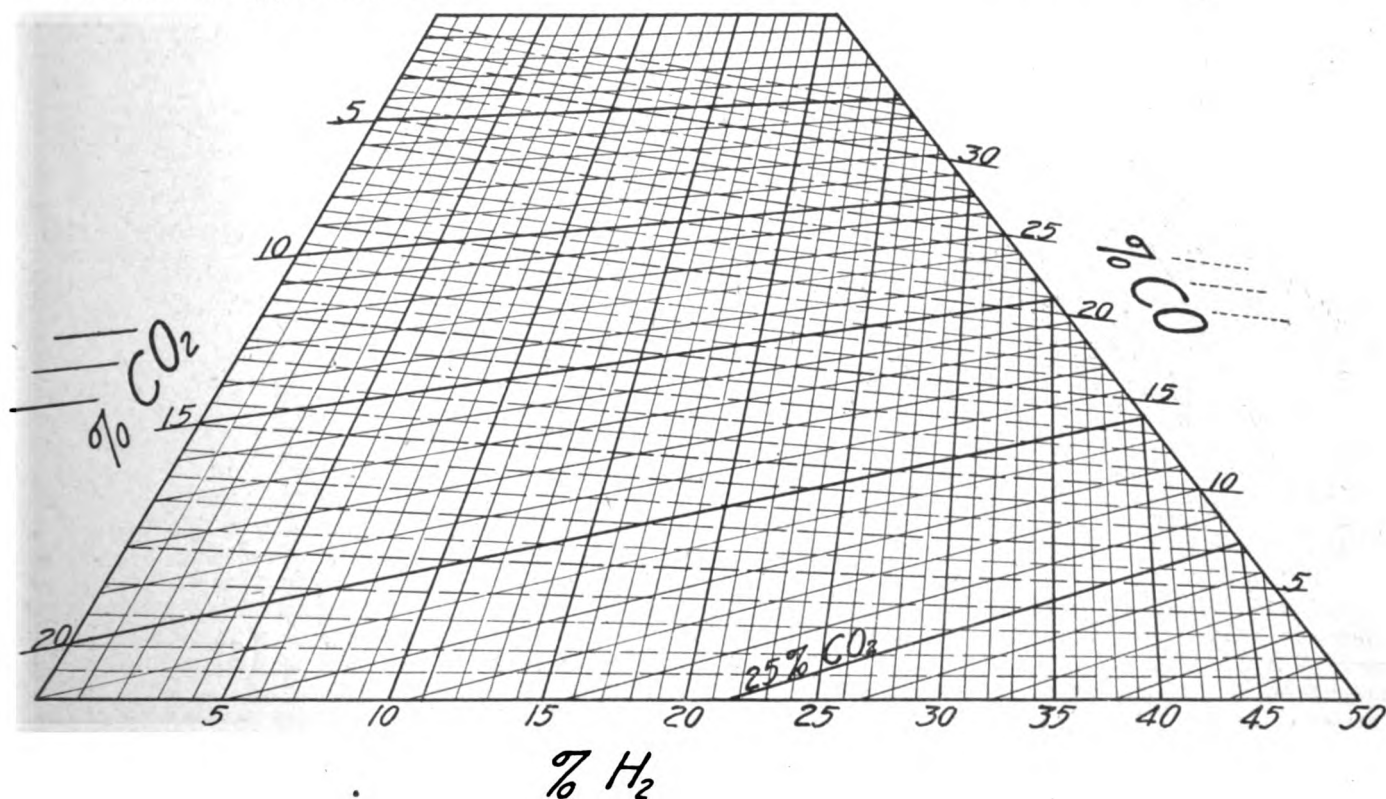


Fig. 5.

from 1 (equivalent) cu. ft. of carbon = $2a + 2b - 2c + 4c + 4b + \frac{15a}{2} = \frac{19a}{2} + 6b + 2c$. And since $(a + b + c) = 1$, this sum may be written in the form $\frac{19a}{2} + 6b + 2(1 - a - b) = \frac{15a}{2} + 4b + 2$.



% H_2
Chart for Gasification of Pure Carbon

Fig. 6.

The proportion of CO_2 by volume, designated by the symbol k , may be expressed as

$$k = \frac{\% \text{CO}_2}{100} = \frac{2a + 2b - 2c}{\frac{15a + 4b + 2}{2}} = \frac{2a + 2b - 1}{\frac{15a + 2b + 1}{4}}$$

From this equation,

$$\frac{15ak + 2bk + k}{4} = 2a + 2b - 1$$

Solving for b , we find

$$b = a \left[\frac{15/8 k - 1}{1 - k} \right] + \left[\frac{k + 1}{2 - 2k} \right] \quad \text{I.}$$

The proportion by volume of CO , designated by p , is

$$p = \frac{\% \text{CO}}{100} = \frac{4c}{\frac{15a + 4b + 2}{2}} = \frac{2 - 2a - 2b}{\frac{15a + 2b + 1}{4}}$$

$$b = \left[\frac{2 - p}{2 + 2p} \right] - a \left[\frac{1 + 15/8 p}{1 + p} \right] \quad \text{II.}$$

The proportion by volume of H_2 , designated by h , is

$$h = \frac{\% \text{H}_2}{100} = \frac{2b}{\frac{15a + 2b + 1}{4}}$$

$$b = \left[\frac{h}{2 - 2h} \right] + a \left[\frac{15/4 h}{2 - 2h} \right] \quad \text{III.}$$

To locate points on that line in the triangle which corresponds to a given fixed percentage of CO_2 , values of b corresponding to various values of a are calculated from equation I above for the constant value of k . For each pair of values, a is laid off in Fig. 4 as length

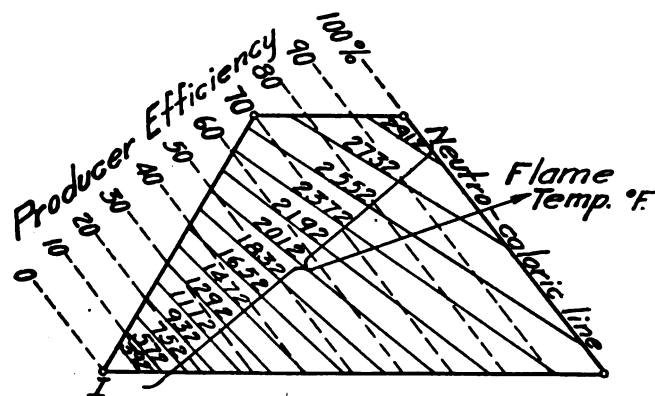


Fig. 7.

III — 4, and b is laid off as length 4 — 5. Line 4 — 3 is drawn parallel to side of triangle III — II, and line 5 — 3 is drawn parallel to side I — II. Their intersection locates point 3.

Now it can be proved quite simply, by the methods of analytical geometry, that the locus (line 1 — 2) of all points corresponding to a fixed CO_2 content is a **straight line**,—hence for constructing the network of lines of constant CO_2 content, it is only necessary to locate corresponding points 1 and 2 on lines I — III and II — III, and to draw straight lines connecting

1 with 2. To locate point 1, equate b to zero, in equation I.

$$a = \frac{\left[\frac{k + 1}{2 - 2k} \right]}{\frac{15/8 k - 1}{1 - k}} = \frac{k + 1}{2 - 15k/4}$$

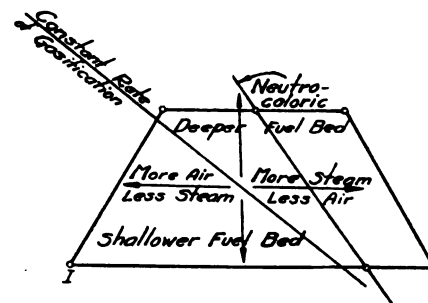


Fig. 8.

For each value of k , the fraction a is calculated, and is represented by length III — 1, such that

$$a = \frac{\text{length (III — 1)}}{\text{length (III — I)}}$$

To locate point 2, equate a to zero in equation I.

$$b = \frac{k + 1}{2 - 2k}$$

The calculated value of b may be laid off on line I — III and a parallel to line I — II may be drawn to intersection with II — III; or more simply, b may be laid off directly on line II — III to such scale that

$$b = \frac{\text{length (III — 2)}}{\text{length (III — II)}}$$

Example: Locate the line representing constant CO_2 content of 15 per cent.

$$\text{When } b = 0, a = \frac{k + 1}{2 - 15k/4} = \frac{.15 + 1}{2 - 15/4 \times .15} = .80$$

If the sides of the triangle I — II, II — III, and III — I, (Fig. 4) are made 10" long, then $a = .80 = \frac{\text{length (III — 1)}}{10"}$

Length (III — 1) = 8" and this locates point 1.

$$\text{When } a = 0, b = \frac{k + 1}{2 - 2k} = \frac{.15 + 1}{2 - .30} = .676$$

Then length (III — 2) is $.676 \times 10" = 6.76"$. This locates point 2.

Lines of constant CO (as 6—7, Fig. 5), and those of constant H_2 (as 8—9), can also be proved to be straight lines. To construct these lines, it is only necessary to find their end points, as 6 and 7 for CO , 8 and 9 for H_2 ; and to connect the corresponding points by straight lines.

For constant CO content, point 6 is found by equating b to zero, in equation II.

$$\text{Then } a = \left[\frac{2 - p}{2 + 2p} \right] \div \left[\frac{1 + 15/8 p}{1 + p} \right] = \frac{2 - p}{2 + 15p/4}$$

length (III—6) = $a \times$ length (III—I)
Point 7 is found by equating a to zero.

$$b = \left[\frac{2 - p}{2 + 2p} \right]$$

length (III—8) = $b \times$ length (III—II)

For constant H_2 content, point 8 is found by equating a to zero, in equation III.

$$b = \frac{h}{2 - 2h}$$

In Fig. 5, length (III—8) = $b \times$ length (III—II). Point 9 is found by equating the sum of $(a + b)$ to unity,—that is, $c = 0$.

$$(1-a) = \frac{h}{2 - 2h} + a \left[\frac{15/4 h}{2 - 2h} \right]$$

$$a = \left[\frac{2 - 3h}{2 + \frac{7h}{4}} \right]$$

Lay off length (III—10) equal to $a \times$ length (III—I), and draw line 10—9 parallel to III—II to intersection point 9; or else (more simply) lay off length (II—9) = $a \times$ length (II—I). As the triangle is equilateral, I—II = II—III = III—I.

The chart of Fig. 6 has been constructed in this manner. It may be noted that the lines of CO_2 and H_2 are nearly at right angles. This means that their intersection points are sharply defined and that from an analysis showing only CO_2 and H_2 , the corresponding CO content can be found quite accurately. This is an advantage, because no good reagent is known for absorbing CO in the gas analysis, whereas excellent absorbents for CO_2 and H_2 are known. The chart can be applied very advantageously to indications of these constituents from such instruments as the Mono recorder.

The chart of Fig. 6 applies only to gas produced from coke or anthracite. Producer gas formed from bituminous coal or from lignite contains also methane, ethylene, and the additional hydrogen which is formed by the breaking up of the hydrocarbons. In the chart constructed by Claus and Neussel, Fig. 3, a correction was introduced for the methane, but not for the extra hydrogen. Gas from bituminous coal always contains more hydrogen than the chart (Fig. 3) shows, but the amount of excess hydrogen is indeterminate for this reason: The amount of extra hydrogen depends upon the temperature at the top of the producer; the higher this temperature, the greater the extent to which the hydrocarbons are decomposed, and the greater the amount of extra hydrogen produced.

But the top of the producer is hottest, when gasification proceeds with reactions which are represented by points near the left hand bottom of the trapezoid, Figs. 1 and 3, and the top of the producer is coolest when working with reactions near the right hand boundary (neutro-caloric line). The amount of hydrogen added to all other gas quantities will, therefore, vary in the diagram from place to place even for a given coal. This reasoning shows that, for the drawing of an absolutely correct gasification and distillation chart for bituminous coal, additional experimental data must be gathered. Even with such data at hand, the making of the chart will be difficult and tedious in the extreme.

In the before-mentioned publication, Claus and Neussel point out that interesting data can be gathered from the gasification chart for coke or anthracite. Fig. 7 was adapted from their publication without recalculation of the flame temperatures. The illustration shows that producer gas represented by the upper right hand corner of the chart gives the highest flame temperatures, while gas represented by the lower left hand corner gives no temperature rise whatsoever,—it being understood that all gases are cooled to room temperature before combustion. The chart also permits the reading of the producer or gasification efficiency (neglecting the heat in the steam) for any given possible gas analysis. The lines of constant efficiency are taken directly from Ostwald's book, p. 54. For gas produced from bituminous coal, lines of equal flame temperature, and of equal gasification efficiency can be computed, but the work is so slow and tedious as to deter anyone who is working solely for the enlightenment of his fellow citizens.

The man who has charge of gas producer operation will dismiss this whole discussion as purely academic and as one-sidedly theoretical, unless it helps him to so change the operation as to produce a better gas. With a given producer, and with a given gas demand, the following changes can be made in the operation:

- 1) Variation of steam supply.
- 2) Variation of air supply.
- 3) Variation of depth of ash bed.
- 4) Variation of depth of fuel bed.
- 5) Use of a non-clinkering coal, or else more frequent cleaning of the producer.

The present article is not a treatise on gas producers and upon their operation, and for that reason it will be impossible to go into details on the question of how a producer must be designed to furnish the best possible gas. All that can be done is to indicate on the chart (see Fig. 8) what the general effect of the different variations is. (This part is partly adapted from the publication of Claus and Neussel.) It would be intensely interesting to follow in the diagram the effects of more or less uniform steam and air distribution over the cross section of the producer, the effects of channeling by nozzles, or the effect of deep ash beds upon the quality of the gas and upon the required pressure for blowing steam and air into the producer, but these problems are big enough to warrant a separate publication which should, by right, originate with one of the producer builders.

BRITISH IRON AND STEEL INSTITUTE.

The British Iron and Steel Institute will hold its annual meeting Thursday and Friday, May 4th and 5th, at the House of The Institution of Civil Engineers, Great George Street, London. The annual dinner will be held the evening of Thursday, May 4th, at the Connaught Rooms, Great Queen Street, London.

Members of the Iron and Steel Institute have been invited to participate in the next International Geological Congress which is to be held at Brussels in August, 1922.

During the Congress, excursions will be made to Quenast, to the caves of Han and Rochefort, to the cave and district of Remouchamps, to Liege, Spa and neighborhood, to the valleys of the Sennette and Samme, to Namur and the Samson fault, to Landelies, to the Tertiary Formations (Eocene) near Brussels, and to Louvain (Coal-mining Museum).

Description of Test on Furnace Sand

Investigation of the Thermal Conductivity of Sand—Practical Values for Use by Furnace Designers—Description of the Apparatus Used.

By M. W. MAWHINNEY

Assistant to Prof. Trinks, Carnegie Institute of Technology

THE matter of the conductivity of sand at high temperatures has long been a doubtful factor in the calculations of the designers of muffle furnaces and other furnaces where sand is used in the construction. In an attempt to improve this situation, the following test was devised and performed to furnish some guide to assumptions in the future. With the apparatus at hand, it was not possible to perform an extremely accurate test, but it appeared that if a reliable comparison could be made between a specimen of sand and of ordinary firebrick under the same conditions, the results would be of sufficiently practical value for furnace design. This method was therefore selected, and the apparatus designed accordingly.

Description of Apparatus.

The details and arrangement of the apparatus are clearly shown in Figs. 1 and 1a. The furnace used for the test was a Tate-Jones gas fired type, having a heating chamber about 18x14x7 in. The door was removed and

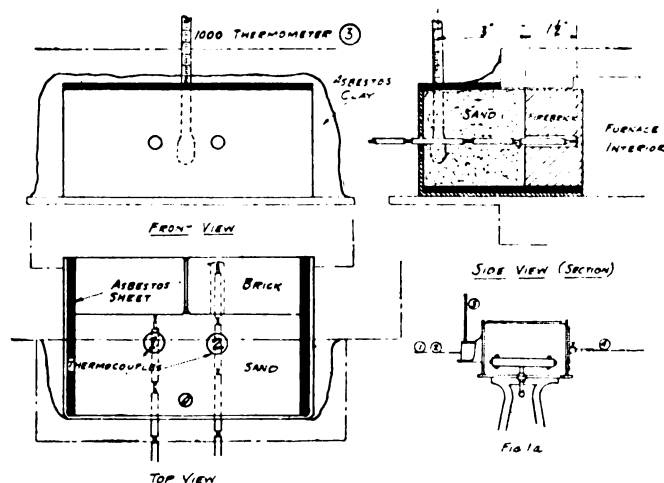


Fig. 1.

the apparatus fitted into the opening in the brickwork. The apparatus itself consisted of a sheet iron container without top or back, the back being replaced by a wall of firebrick about $1\frac{3}{4}$ in. thick. The enclosed space was lined on sides and bottom with sheet asbestos to minimize heat losses and filled with the specimen of foundry sand tested. Sheet asbestos was fitted over the top, and the whole thing packed into the furnace opening with asbestos clay. The asbestos sheet is shown by the shaded portion of Fig. 1. The dot-and-dash lines are the outlines of the furnace proper, and show the relative position of the apparatus.

Investigation of the Thermal Conductivity of Sand.

Temperature measurements were taken at four

places, three as shown on Fig. 1, and the furnace temperature with a pyrometer located as shown on Fig. 1a. All pyrometers used were platinum-rhodium couples. One is a pyrometer located in a hole bored in the brick $1\frac{1}{2}$ in. deep from the junction of sand and brick, and to within $\frac{1}{4}$ in. of the surface of the brick inside the furnace. Two is a pyrometer placed just at the junction of the sand and brick. Three is a thousand degree

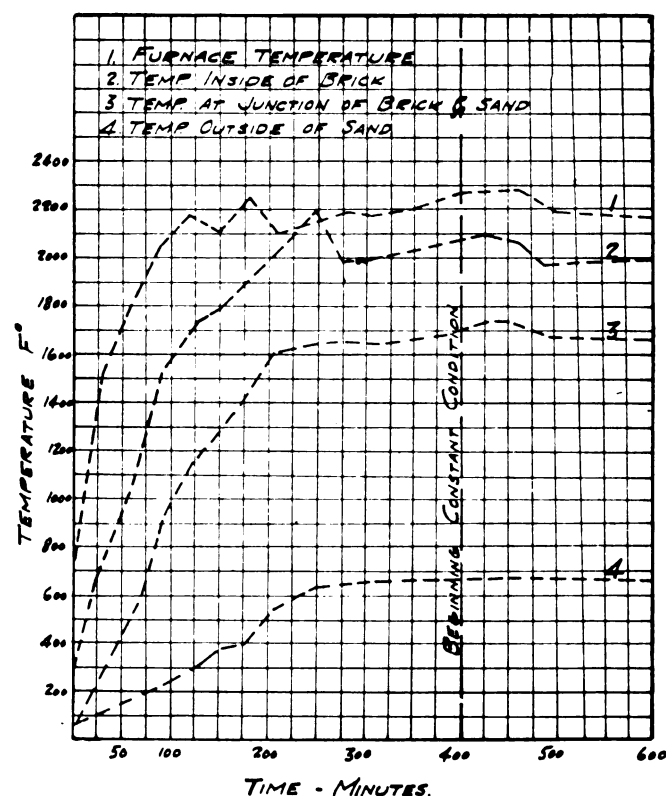


Fig. 2.

thermometer 3 in. from the junction and $\frac{1}{2}$ in. from the surface of the container. Four is a pyrometer contained in a silica tube and placed in the interior of the furnace.

Performance.

The temperature of the furnace was brought up gradually to about 2200 deg. F., and kept as near this temperature as possible for about eight hours to insure a steady flow of heat through the brick and sand. Temperature readings were taken every half hour throughout this period. At the conclusion of the test all of the instruments were carefully calibrated.

Results.

Fig. 2 shows the variation of the temperatures at the different points with time. From a study of the curves

it appears that the flow of heat became constant during the last four hours of the test. Averaging the temperature readings at the different points over this period, we find that the average temperature at the inside of the brick was 2029 deg. F., at the junction of the brick and sand 1689 deg. F., and at the outside of the sand 668 deg. F. Therefore, the temperature drop per inch

through the brick equals $\frac{2029-1689}{1\frac{1}{2}} = 227$ degrees,

while the temperature drop through the sand equals $\frac{1689-668}{3} = 340$ degrees per inch.

Now, assuming no heat loss through the sides (and this is reasonable as those surfaces were practically cold throughout the test) the conductivity will be inversely proportional to the heat drop. Therefore,

$\frac{\text{conductivity of sand}}{\text{conductivity of brick}} = \frac{227}{340} = .67$ between 700 and 1700 deg. F.

Selecting an average value of 9 Btu. per sq. ft. per deg. F. per inch thickness for the thermal conductivity of firebrick, the conductivity of sand obtained from this test is about $.67 \times 9$, or 6 Btu. per sq. ft. per deg. F. per inch thickness.

That this is but a rough constant for practical use only can readily be seen from a study of the conditions. In the first place, the value is only an average between the temperature limits of 700 and 1700 deg. F. Also the fact that the brick was heated to incandescence throughout, and part of the sand also became red hot would indicate that the factor of radiation also had some disturbing effect. However, since the conditions in the test were approximately the same as those met in furnace practice, the value obtained will serve as a guide until more accurate investigations are undertaken.

The Electric Furnace Situation

Dealing With the Widening of the Sphere of the Electric Furnace's Operation—One of the Most Interesting Developments Is That of Making Cast Iron in the Electric Furnace.

OBSERVATIONS on the existing status of the electric furnace and predictions on its future application have periodically appeared in the technical press with at least annual frequency. The majority of these publications have been more or less statistical, showing the electric furnace's position in the metal industries by the increase in the number of installations. There is quite sufficient evidence in every quarter of the country to establish the claim of the electric furnace as an accepted and standard type of melting apparatus. It has arrived at such a status by sheer force of its inherent merit and metallurgical flexibility, and further, in spite of a certain amount of misdirected effort and application, faulty and freak design, unintelligent experimentation, and super-enthusiasm of some of its most ardent proponents. But it is standard now and certainly bids fair to remain so and to be accorded even greater favor. Due to the low tide of production of practically every sort, particularly the metal industries, a comparison of the increase in number of installations in the past year to that in the three or four preceding years is by no means correctly indicative. But it should be pointed out that in comparison to the average of business generally the electric furnace undoubtedly has done a larger percentage of a normal year's business than any of the steel or iron industries. The electric furnace has done almost half a normal year's business in 1921, which is in reality an actual gain over preceding years. But a more important phase of the situation is the widening of the sphere of the electric furnaces' operations with which consideration this article is most directly concerned.

The electric furnace as a general term is a pretty comprehensive one and its development is a rather wide subject. These remarks are confined to its applications on the ferrous metal fields. But even this one class of

applications, the electric furnace is unique in that it has gone into every branch of the iron and steel industry. The cupola has hitherto been supreme in the cast iron, the air furnace in malleable production, the Bessemer and the open hearth in the steel castings and rolling ships, and the crucible in the tool steel. So it has previously been the case that each type of steel or iron shop had a special type of melting. The electric furnace is in strong contrast with these other types of melting equipment because it has been successfully utilized in every one of the various types of iron and steel working industries.

Malleable Iron.

In the malleable shop, the greatest tonnage has been produced by the Kranz triplex process. This process utilizes a very large percentage of scrap, using the converter to reduce carbon and manganese after melting in the cupola. Sulphur is then reduced and the metal superheated in a basic hearth electric furnace. Another feature of this system is the ability it possesses of holding a charge at a constant analysis and temperature. The main objection to this is the floor space and capital tied up in the three types of equipment necessary. To cold melt a charge of scrap steel and iron adjusted to give a proper carbon and silicon content for a malleable specification in a basic hearth is not satisfactory for the reason that little or no reduction of manganese takes place, while almost total desulphurization occurs. The sulphur-manganese balance is thus not secured. It is, therefore, not highly probable that malleable will ever be extensively synthesized by the basic hearth electric.

Experiments have been made with the acid hearth electric with full charges of cheap steel scrap which indicate that a very excellent malleable specification can cheaply and almost automatically be obtained by this method. Several companies have been investigating

this method and the next year will in all probability see some installations of this nature made. It is also very probable that the acid hearth will find greater favor in the malleable field than the basic. Combinations of the two will probably be worked out also.

Steel Casting.

So much has been written about the metallurgy and quality of electric steel castings that no attention will be given it here, and the superiority of it for this type of work is considered accepted. But for the production of very large steel castings the open hearth is still firmly lodged in its position. However, shops specializing in this large work usually have to take a certain amount of small work along with the large patterns and its production from the big open hearth heats is quite a difficult matter. The steel for this big work is of necessity tapped too cold for the small stuff so that the small casting production is usually a losing game. And years like the present one place these people at a disadvantage. The work which is secured is not sufficient in volume to keep the open hearth busy and the shop equipped with the average size of open hearth to be found in the steel castings shop finds itself in a position where they face shutting down or making two or three heats a week, keeping the furnace hot the rest of the time. Either of these courses of action is highly undesirable, the one resulting in the loss of a certain percentage of clientele and the other in a loss of a certain amount of money. These people are resorting in several cases to the expedient of installing a small electric furnace to take care of the small work during periods of active business and all production in slack times. In doing this the open hearth shop also finds itself in position to take on a very much larger tonnage of small work than the cold melting electric equipment would allow. This they can accomplish by taking a duplexing heat from the open hearth when it is tapped and giving it in the electric, the temperature necessary for pouring small work.

Alloy Steels.

In the alloy steel industry, there is a very interesting development in the past year, in that, so far as cost is concerned, the alloy steels, once providing the strongest impetus the electric furnace ever received, have temporarily reversed themselves. This condition is due to several developments coming out of the business depression. During the past period of expansion and prosperity, the demand for alloy steels for ordnance and automotive uses got beyond all proportions of the country's productive capacity. The price was accordingly very high, in common with that of the ferro-alloys, fuel, etc. The rise in power rates was much slower than the prices of other commodities entering into the cost sheet. The saving in the alloys recovered, grade of scrap available for electric furnace utilization, but not available for open hearths, difference in price between this scrap and heavy melting steel, and other materials dictated the use of the electric furnace, resulting in a greater expansion than any other type of steel melting equipment has ever had in the same time, in point of installation numbers. With the decline in prices of fuels, alloys, etc., came no corresponding decline in power rates, these latter being under state regulation and consume, in effecting changes, a great deal more time than commodities, the prices of which operate under the law of supply and demand. The consequence of this has been that the past year has seen by far the majority of the automotive steels melted in the open hearth by the people who were open hearth equipped, and sold at a price much lower than the open hearth

people liked to work on. This condition is an artificial one, just as the condition where electric furnace operation was so out of proportion was artificial. With the gradual return to normal conditions the production of alloy steels, which have been called electric furnace steels, will revert in a large degree to electric furnace production. In what degree or percentage is a question as answerable as when will business be good, and also one to be decided from time to time by recourse to pencil and paper and cold arithmetic, the matter of electric steel's superiority over open hearth steel being duly taken into account. But it is quite certain that during the year of 1922 a greater percentage of these "electric furnace steels" will be electric furnace melted.

The type of operation will also be decided by cost, i. e., where melting can be more economically accomplished by fuel, the scrap will be fuel melted and electrically alloyed and refined. Various combinations have been worked out, and it is quite possible that duplexing will have a wider use than in the past. Triplexing will always very probably be confined to works with blast furnace and equipment.

Tool Steel.

In the tool steels it is very probable that the electric will slowly but surely continue its encroachments on the crucible. With the increased knowledge of the art and the higher type of intelligence doing the actual melting work, better judgment in designing charges and carrying out furnace operation are overcoming the prejudice in favor of crucible steel. Poor workmanship on electric furnace operations has caused a great deal of poor grade tool steel to be turned out, which suffered in comparison with the crucible product. But the *active* refining tendency of electric furnace metallurgical conditions, when properly used, enable the electric furnace product to be much freer from inclusions than the cupola. This has been clearly demonstrated in at least one plant during the past two years.

Another interesting development of the art during the past few months has been the advent of an acid electric tool steel. The company manufacturing this steel states it is superior in many ways to the basic electric steel. This company is in fair position to give an opinion, operating as they do, a basic electric furnace.

In the production of steel the electric, even with a high power rate, will always be cheaper than the crucible product in manufacture, owing to the cost of the pots.

Cast Iron.

Of all the recent electric furnace developments, probably the most interesting and, from the trade's standpoint important, is its encroachment in the field of the cupola. Starting out, as the electric furnace did, in the tool steel industry, and as before mentioned, obtaining the greatest impetus in the alloy steels, both of which are the most expensive type of iron metals, in the year in which something of a recession has been noted in the electric production of these materials, the electric furnace has seen its largest gain in the manufacture of lowest priced iron metal, cast iron. This field is one in which the electric furnace will in all probability find its greatest expansion in the next few years. From the cast iron foundries alone, during the past year there have been upwards of a thousand inquiries to electric furnace manufacturers. This amount of inquiry evidences a very decided amount of interest.

Electric cast iron has been extensively advertised in the form of piston rings. Duplexed iron has also been

utilized for valve castings during the last few years. These parts are rapidly assuming the same rate in the iron field that the alloy steels have played in the steel shops, i. e., essentially an electric furnace proposition. In time, it is also very highly probable that chilled rolls, cylinder liners, cylinders, automobile valve seats, glass bottle moulds, and various other parts now either cupola or air furnace cast, will enter the "electric iron" heading, just as chilled rolls have already largely done in Sweden.

But, during this year, one of keen competition and falling prices, the country has very probably for the first time seen a foundry shut down its cupola and turn its iron into the electric for primarily pure economic reasons. The Queen City Foundry Company has done this and have, while improving the quality and control of their iron, used scrap and cut their costs. Locality, of course, plays a certain part on such a condition, but such a condition is not peculiar to any one major section of the country, and is decidedly operative from the Rockies West, as well as many localities such as Chicago and other industrial centers. This condition will, of course, be narrowed as the practice of charging cheap scrap into electric furnaces gains more popularity. But such a condition cannot be adjusted further than the point where the margin between scrap and pig isn't sufficient to allow the difference in cupola and electric furnace cost. The demand for such scrap would then fall off, pig being then purchased.

There are one or two points in the electric metallurgy of cast iron which are still mooted questions, but the claim that borings in full charges cannot be completely melted in stationary or non-oscillating types of the direct arc furnace is not substantial. Complete charges of borings can be melted in the direct arc iron oscillating furnaces of at least two types, with practically the same power input as for heavier charges, and for about 10 per cent less power input than is averagely obtained in the indirect oscillating type furnace. This has been accomplished on numerous occasions.

An example of one type of control obtainable in the electric furnace is hardness. In a foundry making glass bottle moulds with a 500-lb. electric furnace, before heats were tapped, a test bar is poured into a dry sand mould. It is left a certain length of time in the sand (about three minutes) and then allowed to air cool till black, which takes about seven minutes. The bar is then water quenched, broken, one end ground and Brinelled. Very accurate hardening results are obtained by making such additions to the bath as are necessary. This is in itself quite an innovation in the iron foundry in this country.

As an indication of the diversity of uses of the electric furnace in the iron foundry, there are at present the following wide variety of electric furnace iron castings now produced in the states: Piston rings, locomotive cylinders, grate bars, valves, large and small, ball mill chilled liners, soil pipe and fittings, sewer gratings, high pressure steam fittings, glass bottle moulds, etc.

In all situations the ratio between power rate and scrap pig and pig and coke cost have to be the deciding factor in the economies. In some instances economies are not major considerations, being subordinate to the quality factor, but as above mentioned, power rates are lagging behind the price trend in other commodities. These will, of course, in time, in large part, be adjusted. But at least two instances have been carried out to a final stage and resulted in the decision that electrical furnaces are a preferential load and are therefore entitled to a preferential rate. A precedent of this sort is a very important one, and one of the companies issuing such a preferential electric furnace schedule had seen the advantage to their business of electric furnace loads and actively solicits such loads. More of this sort of action will, of course, result to benefit the central stations, power consumers and furnace manufacturers.

The electric furnace has had a phenomenal growth, with, be it said, the usual youthful maladies. It has survived, however, and its maturity promises to be even better than its adolescence.

Roller Bearing Mill Tables

A Description of New Rolling Mill Tables in Which Were Installed Flexible Roller Bearings—International Nickel Company Among Prominent Users.

By J. M. KELLY
Engineer, Hyatt Roller Bearing Company

THE reliable performance of the flexible roller bearing on mill table equipment is becoming more and more pronounced, and during the year 1921 additional rolling mill tables have been designed and built with the flexible roller bearing incorporated on the table rollers and side shafts.

The International Nickel Company, Huntington, W. Va., will soon place in service a 24-in. sheet bar mill, and for a length of 260 feet the approach and runout tables will operate with Hyatt roller bearings. This mill was designed by F. I. Ellis, consulting engineer, Pittsburgh, Pa., and these auxiliary tables were built by the Connellsville Foundry Machine & Steel Castings Company, Connellsville, Pa.

The 24-in. sheet bar mill recently installed at the Mansfield Sheet & Tin Plate Company, Mansfield, O., includes flexible roller bearings on 400 feet of table. This mill was designed by F. I. Ellis and Barton R. Shover, consulting engineers, Pittsburgh, Pa., the table equipment being built by the Woodard Machine Company, Wooster, O.

The 12-in. diameter table rollers for these mills are supported in the bearings in the manner indicated. The bearing housings are bolted to the 10x1½-in. slabs and the opposite bearings on the same table roller are aligned accurately.

The bearing housing is in two parts, the top being fastened to the base by bolts.

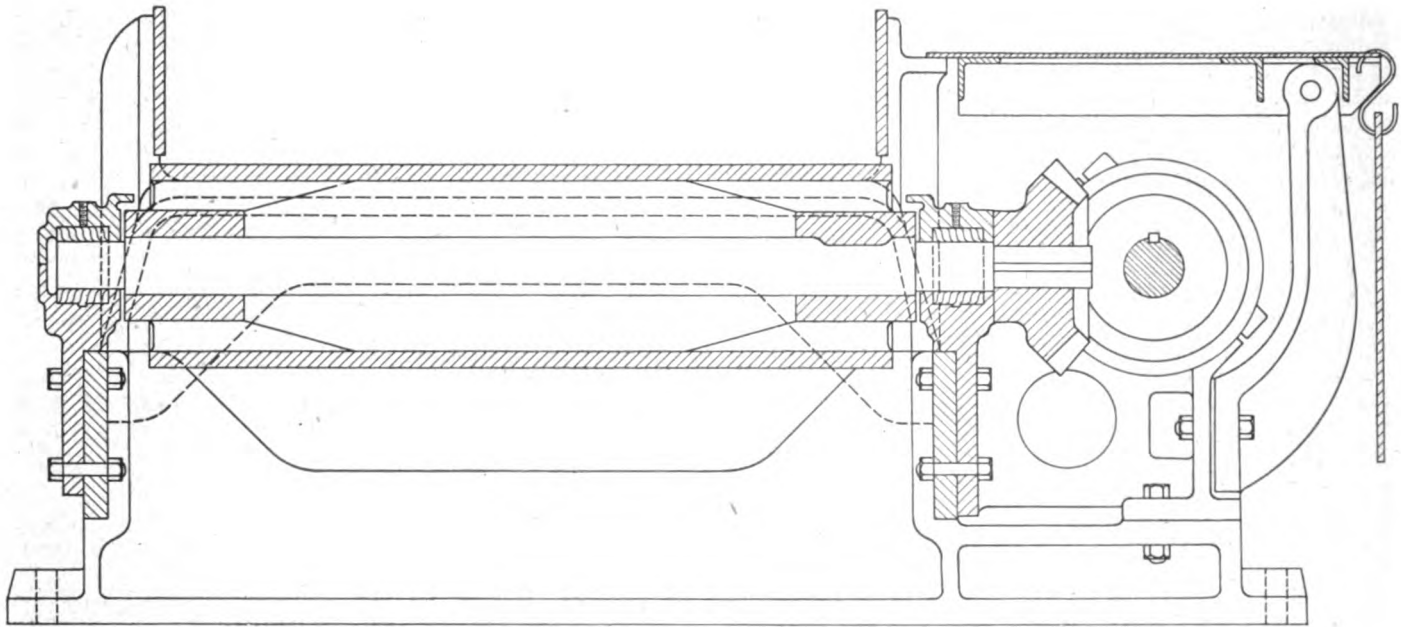


Fig. 1—Design of Hyatt equipped approach and runout tables for 24-in. sheet bar mills at International Nickel Company and Mansfield Sheet & Tin Plate Company.

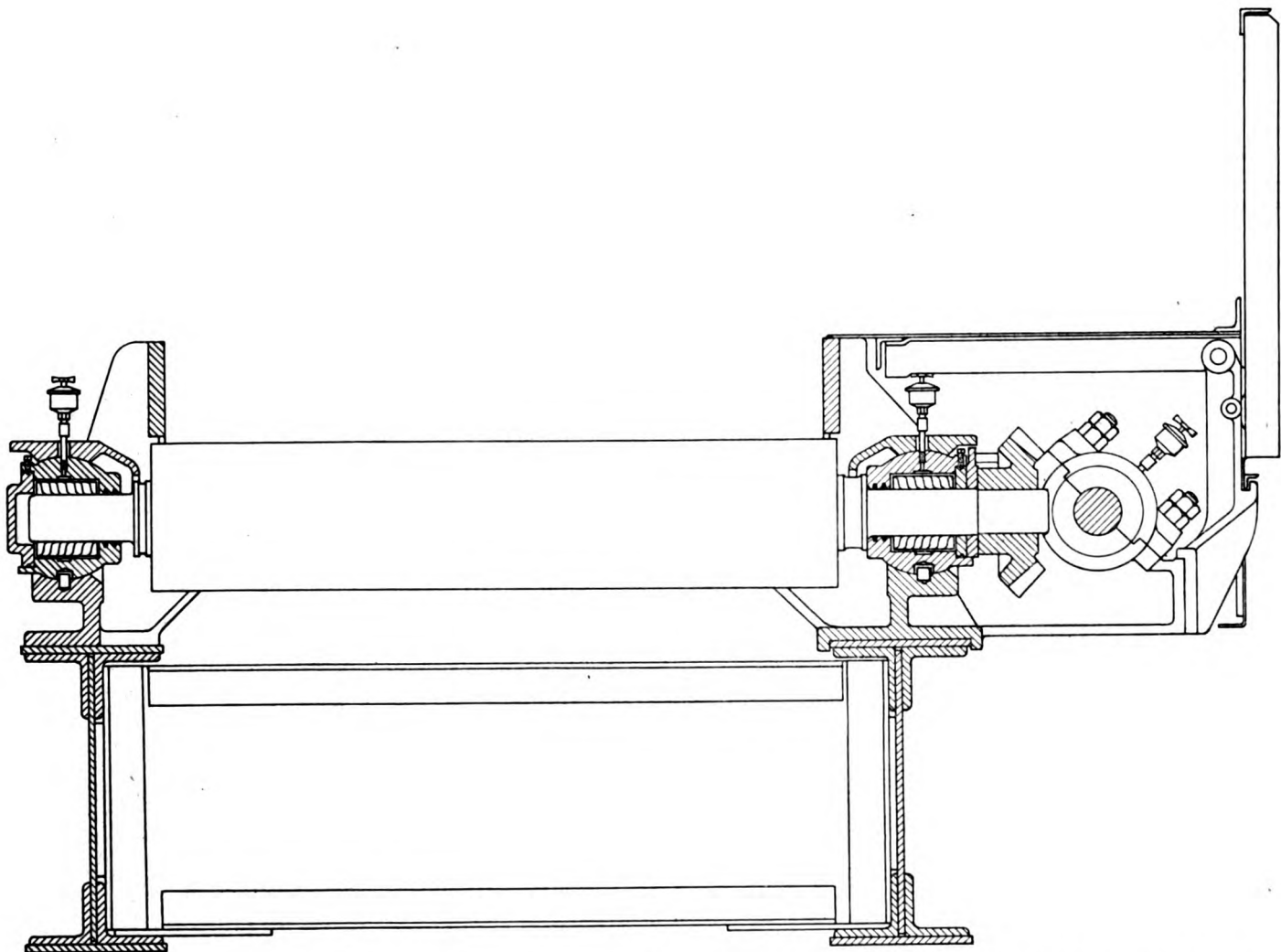


Fig. 2—Design of Hyatt equipped table for 28-in. structural and bar mill for Acieres De Micheville, France, similar to tables now in successful operation for two years at Tennessee Coal, Iron & Railroad Company.

To the many mills designed and built by the United Engineering & Foundry Company, Pittsburgh, Pa., and already in operation with flexible roller bearings incorporated on all table rollers and side shafts, this company has added during the past year a flexible roller bearing equipped table for the 28-in. structural and bar mill to operate at Acieres De Micheville, France.

The construction as shown is identical with the installation that has operated for the past two years on the 28-in. combination structural and bar mill at the Tennessee Coal, Iron & Railroad Company, Fairfield, Ala.

This construction of the table roller and flexible roller bearing journal boxes is also similar to the installation on the 35-in. blooming mill main lifting tables at John A. Roebling's Sons Company, Trenton, N. J. This 35-in. blooming mill was built by the United Engineering & Foundry Company and has been in service for 2½ years.

The roller bearings are enclosed in journal boxes which are self aligning, being spherical on the outside and set into spherical seats both in the cap and in the table girder.

The Gary works of the Illinois Steel Company, Gary, Ind., will shortly place in service a 12-in. strip mill and a 20-in. strip mill. The approach and hot bed tables of these two mills are completely equipped with the flexible roller bearing mounted in the self-aligning, ball-seated journal boxes which have proved a decided advantage on mill table equipment.

Flexible roller bearings have been incorporated in the

table rollers and side shafts of a pronounced majority of the mill tables built during the past five years. The use of flexible roller bearings is of material advantage to operating men, inasmuch as the serious delays often caused by inferior bearings are entirely eliminated and the bill is not held up for table bearing repairs.

Master mechanics have pronounced the flexible roller bearing to be the correct type of bearing for mill table equipment on account of the decreased maintenance necessary, not only on bearings but also on other vital parts, such as gears. With these bearings mounted on the table rollers the gears are held in mesh and alignment, which is extremely important with bevel gears.

The slight increased cost, which is sometimes necessary to incorporate the flexible roller bearings, is offset by the advantages:

Advantages of Roller Bearings on Mill Tables.

1. Saving in power.
2. Smaller motor, which offsets, partly, the higher cost of the bearings over ordinary ones.
3. Since there is practically no wear, the gears remain in alignment, which is very important with bevel gears.
4. Saving in oil.
5. Saving in attendance.
6. No spilling of oil, therefore cleanliness and no danger from fire.
7. Cost of repairs is reduced both on bearings and on gears.

Sheet and Tin Mill Furnaces

Many Improvements in the Furnaces Used for Heating and Annealing Sheet and Tin Have Been Made During the Past Few Years.

By T. J. COSTELLO and J. H. KNAPP

SOME people outside of the sheet and tinplate industry and a few of the younger ones engaged in the trade are under the impression that the manufacture in this country of sheet and tinplate dates back to the days of the McKinley tariff bill of the late '80's, but this is only true of tinplate; iron sheets were rolled in this country about two generations previous to the passing of the McKinley tariff act.

Previous to 1885 sheets were rolled from iron produced in the puddling furnaces and the knobbling or charcoal fire; these sheets were of a very high rust resisting quality.

The method of rolling iron sheets was practically the same as that in use today with the exception that the machinery and power required for the purpose were much lighter, as for example, the rolls of the iron rolling period were 20 inches in diameter against the rolls in use today of 30 inches in diameter for rolling steel sheets.

The tonnage of steel sheets per mill today is about three times that of iron sheets produced on the lighter equipment in the puddle iron days.

As in every other field necessity brought about the few changes that have taken place in the sheet rolling

equipment, as it was soon apparent that the production of steel sheets called for heavier machinery and better furnaces. About 1905 there was a bold effort made by one of the principal sheet and tinplate manufacturing companies at Sharon, Pa., to revolutionize the process by semi-continuous rolling. This method did not prove satisfactory and was abandoned in a few years, although there seemed to be considerable merit in the process for rolling the heavy gauges at least.

Previous to 1890 many mills produced sheets sufficiently flat for the requirements of the trade at that time without the use of cold rolls, and some of them several years after the above mentioned date.

The automobile and furniture trade, which at the present times take a large part of the total sheets produced, require, however, what is known as full finished stock. This makes the cold rolling department a very important part of the operation, also the furnace and method of heating these highly surfaced sheets is of great importance, so much so that there are a number of mills in the country that do not undertake to roll this class of sheets, principally on account of their inferior furnace equipment.

The stamping and deep drawing of steel sheets is

another branch which requires special attention to heat treatment, it having been found that box annealing is not entirely satisfactory for this grade of sheets. The result of these new demands upon sheet steel manufacturers has naturally called for the advice of the metallurgists who in many instances have traced most of the difficulty to the design of the furnaces and the method of heat treatment. About 10 years ago improvements in

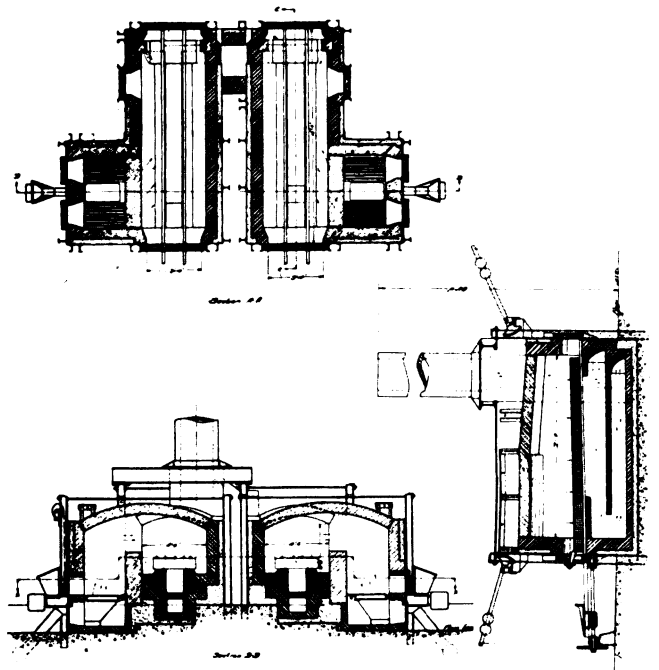


Fig. 1.

the furnace equipment first started and since that time there has been more progress made in sheet and tinplate furnaces than in three generations prior to that date.

The furnace equipment in the early days of the industry was, of course, hand fired and hand charged, being very wasteful in fuel and none too satisfactory in proper heating. The first step toward fuel saving was the Bailey combination sheet and pair furnace where the sheet and pair chambers were built in a block, using a common fire box, the pair chamber being behind the sheet chambers and between the sheet chambers and the fire box.

While this unit was a fuel saver, it had many disadvantages, the main one being that fire must be generally controlled to satisfy the sheet chambers and therefore the pair heater must go along as best he can and in most cases this does not result in very satisfactory heating of the pairs, generally causing excessive scaling and non-uniformity of heating.

While the reheating of the sheets does not readily lend itself to a continuous heating operation, the heating of the pairs does and the first step in the direction of a continuous unit for giving a clean and more uniform heating of the sheet bars was the Allis continuous pair furnace. This furnace was put in operation at Middletown, Ohio, by the American Rolling Mill Company in 1911 and since that time it has been adopted by a great many modern sheet and tinplate plants. While about even with the hand charged furnace in fuel consumption, the first cost, floor space required and maintenance cost seemed to outweigh its good points with many manufacturers. In the Allis continuous furnace the

sheet bars were pushed through the furnace lengthwise, lying in grooves on a cast iron bottom.

The next improvement in furnaces for heating pairs continuously was the Costello continuous pair furnace. This furnace developed about three years ago and was first put into operation in August, 1920, at the plant of the Superior Sheet Steel Company, Canton, Ohio. In this continuous pair furnace the bars are pushed through the furnace standing on edge and they travel on skids made of 3-inch round merchant bars. Fig. 1 shows sectional views of one of these furnaces. It will be noted from the cut that the gases travel over the top of the sheet bars, reach the end of the furnace and then double back and pass through a flue underneath the bottom of the bars, the bars themselves acting as the dividing wall between the two gas passages. The burrs caused by shearing the bars and the unevenness of the bars themselves act as spacers which hold each bar slightly away from its neighbor. This gives a slight space which allows gas to percolate through between the bars and gives a very uniform heat without scale.

The use of the furnace gases both on top of and underneath the bars, giving twice the travel to these gases in contact with the material before they leave the furnace greatly decreases the fuel consumption, also the pushing of the bars through on edge makes possible a much smaller heating chamber for the same tonnage as compared with the Allis furnace. This again means a saving in fuel.

Due to the smaller chamber size and the details of construction the first cost of this type of continuous furnace is very little more than the first cost of the old type hand charged unit; the floor space is considerably less

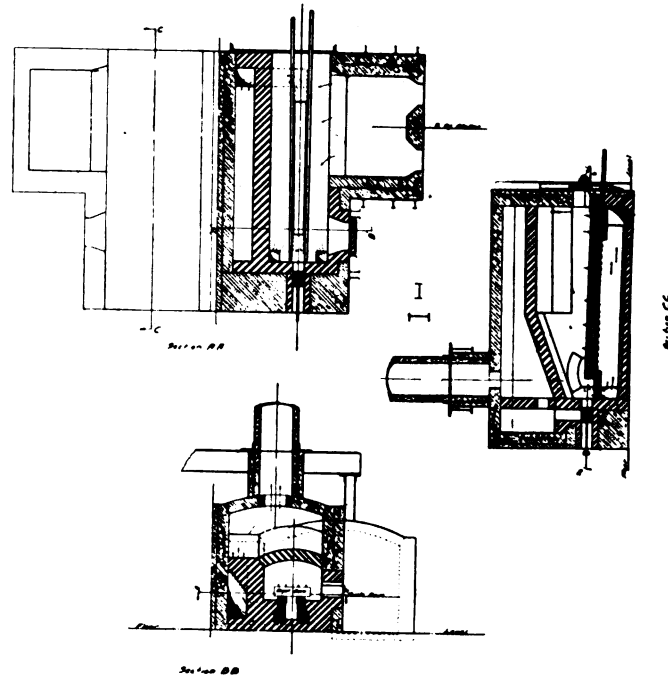


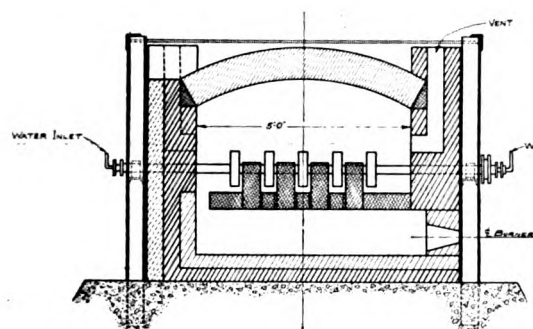
Fig. 2.

and the upkeep or maintenance is exceedingly small, the actual expense per furnace having run \$150.00 per year.

An interesting fact in regard to this design of continuous pair furnace is that it can in some cases be readily built in side of the present hand charged or continuous furnace at very little expense and without tearing down the present furnace equipment; this is due to the much smaller hearth area required for this furnace and to

the method of charging and discharging the bars. Fig. 2 shows a view of the Costello continuous pair construction built inside a continuous furnace of another type. The heavy section lines show the new brick work and the lighter lines the original furnace.

As an example of this is a layout of one double chamber continuous pair furnace and two double chamber sheet furnaces in a floor space 42x48 feet. This is the furnace equipment for two mills and this arrangement saves one complete 20-foot bay of a building over any other continuous or hand charged types. This means that in an eight-mill plant four bays or 80 feet of foundation, 80 feet of bedplate and 80 feet of spindles, which naturally total to quite an item in the first cost of a new mill, are saved. This furnace has proved itself very economical as to fuel consumption and on hand fired units, in an eight-mill plant, shows a fuel consumption of from 175 to 225 pounds of coal per ton depending on the tonnage and the gauge being rolled. A three months average for both sheet and pair heating, taking in light and heavy gauges, showed a total consumption of 385 pounds per ton of finished product from both the sheet and pair furnaces, and as sheet furnaces were of standard type this low figure was due to the economy of the pair furnaces.



Insulation of sheet and pair furnaces seems to have been entirely disregarded, but as fuel economy becomes more and more important the insulation of sheet and pair furnaces is an item which will not be overlooked by up-to-date plant managers.

In the Costello continuous pair furnace a layer of 2½ inches of high grade insulation over the main arch results in a saving of fuel of about 30 pounds of coal per ton of sheet bar heated, when the furnace is operating on full tonnage of average size sheets. The saving on a sheet furnace, operating under the same conditions, would amount to about 8 pounds per ton, or a total of 11 pounds of coal per ton of sheets. The first cost of insulation generally looks high to the average sheet mill manager, but under ordinary conditions and average prices for material, labor and coal, the actual saving can be readily figured and it will be found that ordinarily the insulation of the arches alone on sheet and pair furnaces will have paid for itself in fuel saved in less than two years time.

On sheet furnaces there has been very little change in design or construction except in minor details. Due to the method of handling the material, a continuous furnace of any type seems an impracticability for this heating operation and therefore there are no considerable

improvements that could be made in sheet furnace, although it is possible that some day a continuous sheet furnace will be devised that can be fitted satisfactorily into a mill layout.

After the pair furnace and sheet furnace, we come to the annealing operation or the final heating operation on the sheets. The great bulk of sheet steel made in the country today is annealed in boxes and, depending on the finish desired, gas muffled or not. The annealing of the sheets in boxes is an operation which lends itself readily to a continuous furnace where the production is

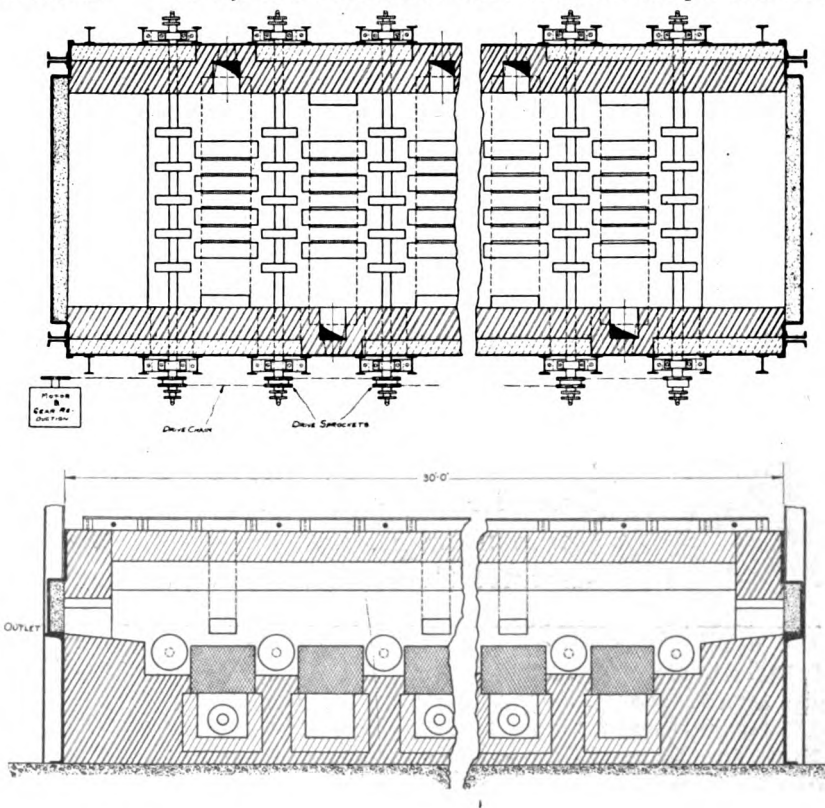


Fig. 3.

fairly constant of the same size and tonnage of sheets as in the tinplate industry. In a number of the larger plants in this country continuous furnaces have been installed for this work. In the sheet industry, however, where the sizes vary considerably and the time element of differently charged boxes changes, a continuous furnace is not as readily adaptable, but in many instances could be used at a very great saving in fuel.

A large majority of the installations in the country at the present time, however, are the single or double box type furnace where the boxes are placed in the furnace, brought up to temperature and then allowed to cool. This naturally is wasteful operation as all of the heat required for bringing up the furnace itself is lost each time, whereas in a continuous furnace the heat required to bring the furnace up is only expended once and then all the heat used, except that lost by radiation from the furnace walls and through the fuel, is the amount required to heat the material.

About 15 years ago there were some experiments carried on in open annealing and while these were not entirely successful, they led to the designing early in 1913 of what is known as the Costello continuous open annealing furnace, three of which were installed by the Otis Steel Company, Cleveland, Ohio. Since that time

many of the more modern plants that have been built have adopted this type of furnace for open annealing in connection with the jobbing mill.

The question of open annealing sheets in gauges from 16 to 24 is the latest problem which has been presented to the furnace designer by the steel plant metallurgists. It has been found that the box annealed sheets do not give the results desired—deep drawn stock, for some grades of automobile work and as what is necessary is not an annealing but actually a normalizing operation. Quite a number of plants are at the present time open annealing or normalizing sheets in gauges from 16 to 24 in furnaces similar to their present sheet furnaces and in fact in some plants this work is done in a sheet furnace. A continuous furnace for this work is entirely feasible and one of a very suitable design is shown in Fig. 3.

In this furnace the sheets are carried on discs made from special heat resisting alloy material as the temperature, required for some of the normalizing work, is higher than the point at which cast iron discs will stand up satisfactorily for any great time. These discs are

properly spaced and shaped so that the light gauge sheets will be satisfactorily carried through the furnace. This type of furnace is underfired, using either oil or gas as fuel. Combustion is complete in the chamber underneath the hearth of the furnace and the sheets receive their heat by radiation and convection from both the top and the bottom. An absolute control of the atmosphere inside of the furnace can be maintained so that there is no danger of oxidizing or scaling the sheets in the furnace. An automatic temperature control device can be satisfactorily applied to such a furnace so that it can be set for a desired temperature and this device without attention from the operator will maintain the furnace at the proper point and insure correct normalizing of the sheets. The time of treatment can be varied by the speed of rotation of the rolls.

As the most important changes and improvements in furnace design and practice have occurred within the last 10 years and as the industries are rapidly expanding undoubtedly still further development along these lines can be looked for in the future.

Description of a Pressed Steel Plant

Brief History of the Reorganization of the Sharon Pressed Steel Company at Sharon, Pa.—It Is Equipped to Manufacture and Assemble Heavy Pressed Steel Products—Routing and Handling.

THE Sharon Pressed Steel Company was organized in June, 1919, with an authorized capitalization of three million dollars in 7 per cent preferred stock and three million dollars in common stock, all having a par value of \$100.00 per share. The company took over the properties and patents of the Hydraulic Drawn Forging Co. of Ellwood City, Pa., and purchased from the Blaw-Knox Company of Pittsburgh its modern plant at Sharon, Pa.

The Hydraulic Drawn Forging Co. had purchased from Follansbee Bros. of Pittsburgh a concern known as the Pressed Steel Truck Co., with patents and machinery for the manufacture of the "Atlas" line of pressed steel trucks, trailers and other equipment for industrial transportation.

The Blaw-Knox Company was a merger of the Blaw Construction Co. with plant and equipment at Hoboken, Pa., manufacturing steel concrete forms and structural steel, and the Knox Pressed and Welded Steel Co. located at Sharon, Pa., in the buildings now occupied by the Sharon Pressed Steel Co. Upon completion of this merger, in order to reduce overhead and consolidate production, a large part of the Sharon equipment was moved to the Hoboken, Pa., plant. Contracts were let to completely dismantle the Sharon plant when Messrs. McGill and McIntyre, with several other influential Sharon people, took steps to save the industry for Sharon. The result was the organization of the Slick-Knox Steel Co. which acquired the Knox plant at Sharon and took over at the same time the Hydraulic Drawn Forging Co. The plant of the latter concern at Ellwood City—which, during the war, was engaged in the production of air craft engine cylin-

ders and forgings—was sold, and activities centered at the Sharon plant.

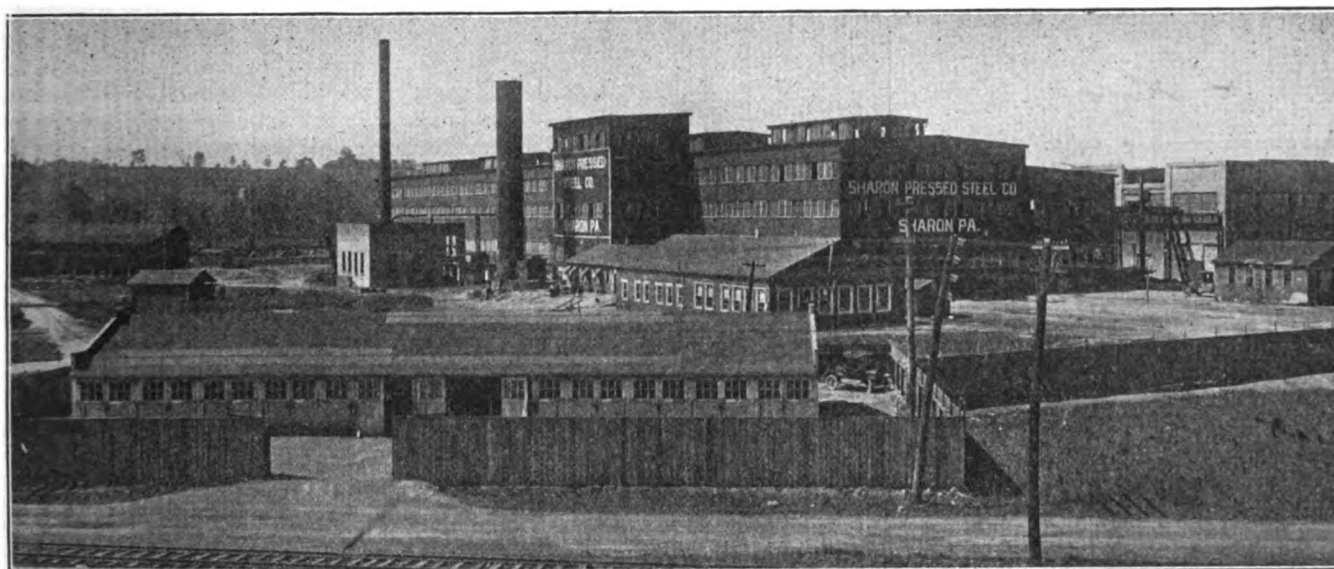
On March 1st, 1921, the Company was taken over for refinancing and reorganization by Messrs. Harry W. Torney of Torney and Co. Inc., Albert W. Morris, formerly of the Harley Co., and Arthur E. Swan, former works manager of the Crucible Steel Co.

Product.

The Company manufactures a complete line of heavy pressed steel products, including:—automobile and motor truck frames, brake drums, step hangers, torque arms, clutch discs, and other parts; pressed steel hand trucks, trailers, dead skids, and other specialties for industrial transportation; pressed steel car roofs, car ends, and journal box covers; and a great diversity of industrial parts and fittings in pressed steel.

Location and Geographical Advantages.

The plant is located at Wheatland, Pa.—a village on the southwestern edge of the city of Sharon—about 60 miles north of Pittsburgh and some 16 miles east of Youngstown, Ohio. This location, in the very heart of the steel producing district, is within easy reach of every source of raw material requisite to the Company's purposes. The lines of the Pennsylvania, Erie, and New York Central Railroads pass the property, providing every facility for quick shipment north, east, south or west. The character of the population of Sharon has enabled the Company to operate with American workmen selected for their skill, experience and intelligence, and unusually free from disturbing factors in labor matters.



View of the Sharon Pressed Steel Company at Sharon, Pa.

Property.

The property lines of the Sharon plant enclose an area of about 93 acres, every foot of which is economically available for factory purposes. The plant buildings, including manufacturing space and storage capacity for raw materials and finished parts, total approximately 30 acres in area. These buildings, while compactly grouped, are so placed that extensions and expansion can be had in four directions without sacrifice of efficient arrangement. The plant lay-out is designed for maximum production at minimum cost, by economical routing and labor-saving methods of handling work and materials. A siding entering the Company property from the adjacent railroad tracks has two branches—one entering the main building at the eastern end—the other skirting the main building and the assembly building at the western end, with a branch serving the scrap bins, boiler house and oil tanks.

Buildings.

The main building, housing the pressed steel and hydraulic forging departments, is of steel frame and corrugated iron construction. Its dimensions are 500 x 115 feet; and concrete piers are in place for an extension of 150 feet at both the north and south ends. The main span of 70 feet is served by three 5-ton and one 15-ton travelling cranes; the secondary bay, or lean-to, with a width of 45 feet, has a 15-ton travelling crane.

Immediately west of the main building, and separated from it by a storage yard 60 feet wide, is the machine shop housing the machine shop, tool making department, and hydraulic accumulators, pumps and air compressors. This building is of brick and steel construction, 250 x 75 feet, with Aiken type roof and travelling crane. The storage yard adjacent is also served by a 15-ton travelling crane.

The assembly building, 300 x 150 feet, lies south of the machine shop and joins the main building at its eastern end. This also is of brick and steel construction, with Aiken type roof, and houses the frame assembly and the department of industrial trucks, trailers, etc. It is paralleled on its southern side by a 30-foot concrete loading platform with railway track alongside.

In addition to these main structures, the plant includes the office building, boiler house, time-keepers'

office, pattern shop and pattern storage and large garage. The Company has its own water supply system and sewage disposal plant.

Machine Equipment.

The plant is electrically driven throughout, power being purchased from the local public service entering the factory grounds at high voltage and being stepped down in the private transformer house. Every piece of machinery in the plant is driven by its own electric motor—an arrangement which minimizes delays due to any causes short of a complete failure of the power supply.

While space forbids a listing of the complete machine equipment, the following units are of outstanding interest because of their size; and they are indicative of the capacity of the plant for the largest and most diversified work in heavy steel pressing. Heading the list comes the 4000-ton Mesta hydraulic rail press—a unit designed and built for the Sharon plant and probably the largest press ever produced. Second in size and capacity stands the 1800-ton Kilby hydraulic rail press. Other notable units are:—a 1000-ton Southwark hydraulic press; an 800-ton Williams White rail blanking press and 18-ft. Shear; a 500-ton Southwark hydraulic press; a 250-ton Hazel hydraulic press; and a 125-ton Southwark hydraulic press; a 125-ton Ferracute crank press. Supplementing these heavy units are batteries of crank presses, shears, punches and power hammers in great variety and covering every possible requirement. Practically all of this equipment is housed in the main building.

In the machine shop there is an exceptionally complete lay-out of lathes, planers, drill presses, etc., specially adapted to the exacting work of tool and die making, as well as for the production of such machined parts as are included in the assembly of the pressed steel products which make up the factory output.

Routing and Handling.

Incoming stock is received and stored at the most advantageous points in the plant, being unloaded direct from railroad cars to storage space. Thence it is handled by travelling cranes throughout the plant along the shortest route and lines of least resistance, so that "lost motion" is eliminated, handling costs minimized, and production kept at top speed.

As the business is fundamentally that of manufacturing in quantity and delivering under stated schedules, the importance of efficient routing and handling cannot be over-estimated; and the plant is designed and operated to conform with these exacting requirements.

Inspection.

The major part of the output is made according to customer's specifications, and consists of a product not merely fabricated but completely assembled. Should a Sharon product be rejected and returned by the customer it is—generally speaking—a total loss except for its scrap value. Herein lies the explanation of, and the necessity for, the exceptionally thorough system of inspection in effect.

This inspection begins with a test of the raw material as received from the mill, to see that it conforms with specifications both as to chemical and physical properties. And from then on, through every stage of forming, machining, fabrication and assembling, every step is under the watchful eye of trained inspectors and every operation checked by the most careful standards. And to this painstaking care is due in large measure the high repute of Sharon products for uniformity of dimensions and quality, and for exact conformity with the customer's specifications.

Heat Treatment and Hardness Testing.

Many products—notably the automobile and truck

frames—are given special heat treatment in order to assure the utmost in the way of structural strength and resistance to deterioration in service.

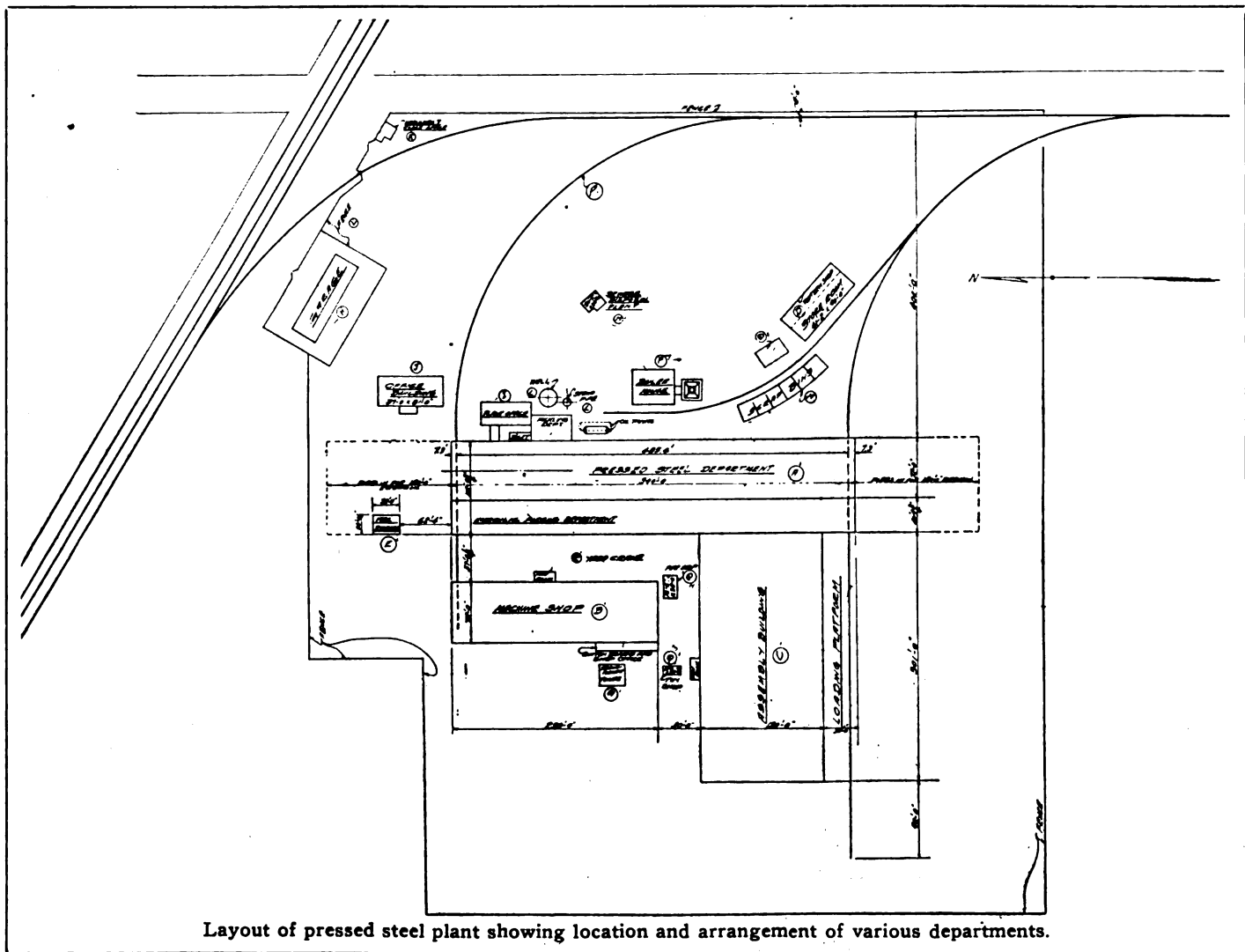
The steels used vary in their character according to customer's specifications. The processes of pressing, bending and shearing through which they pass give rise to internal stresses which, if not relieved, would materially alter the physical characteristics of the material and weaken the structure.

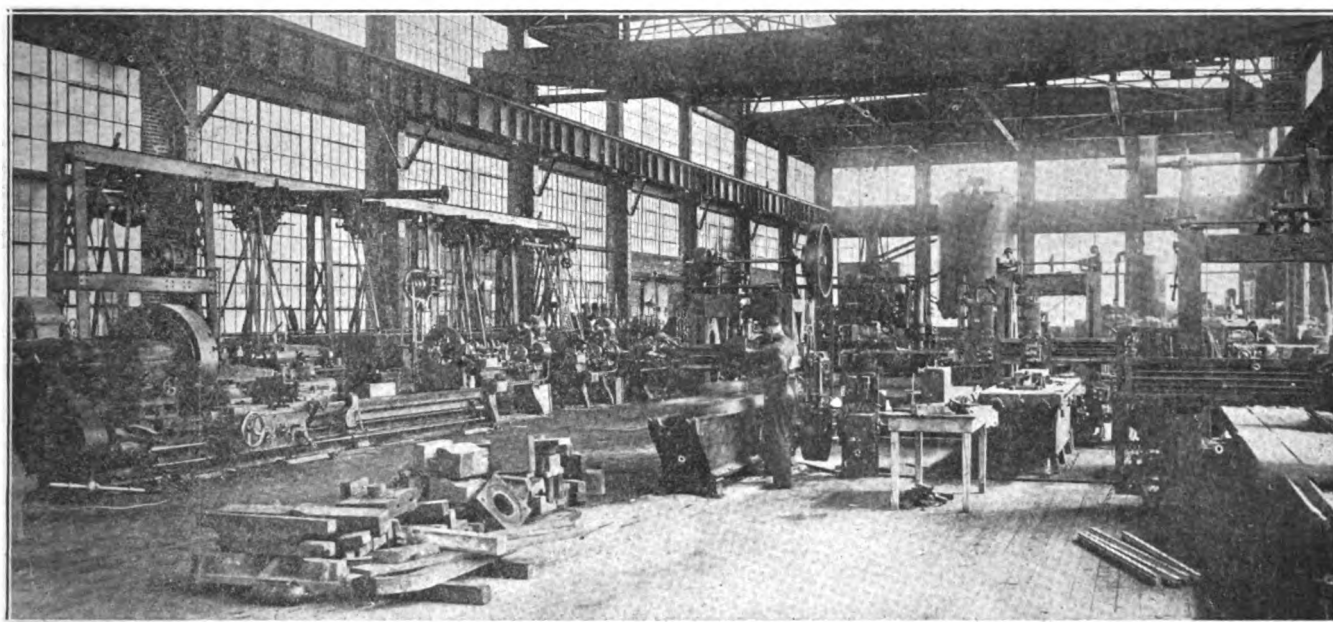
The function of heat treatment is to relieve these stresses and to restore the material to its original condition of maximum strength. While the process is simple in principle, it is made extremely complex in actual practice by the many variable factors determined by the character of the steel supplied and the processes through which it passes. Experts who have specialized in heat treatment know the proper temperatures and the proper times to be used, not only in the heating furnaces but in the quenching baths as well.

Where a certain standard of steel hardness is called for in the specifications, every piece of steel is tested before assembly, by means of a scleroscope; and the reading is marked on the piece or recorded for future reference.

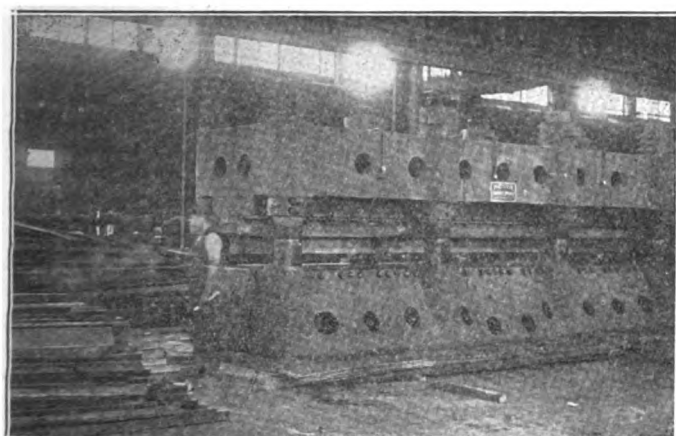
Factory Organization.

The following brief outline of the departmental organization may be of interest—the functions of each





The machine shop of the Sharon Pressed Steel Company is exceptionally well equipped. Each piece of machinery is driven by its own electric motor.



A 4,000-ton Mesta hydraulic rail press, especially designed for this plant. It is probably the largest press ever produced.

department being fairly indicated by its name:

- Drafting Department.
- Purchasing Department.
- Materials Department.
- Production Department.
- Tool Department.
- Machining Department.
- Die Storage.
- Pressed Steel Department.
- Inspection Department.
- Heat Treating Department.
- Pattern Department.
- Maintenance Department.

The present organization includes:

H. W. Torney of Torney & Company, President;
A. E. Swan, General Manager; W. A. Groetzinger,
Assistant General Manager; T. A. Pierce, Assistant
Treasurer; R. B. Reid, Sales Manager.

The working organization of the plant is headed by H. W. Zellman, who was formerly with the Hydraulic Pressed Steel Company, and who is general superintendent of the plant.

J. Curtis is superintendent of Pressed Steel Dept., and Herman Miltenberger is in charge of heat treating and inspection.

A. M. BYERS COMPANY MAKES IMPROVEMENTS

A self-supporting stack to take care of the hot blast stoves has been built for the blast furnace at Girard, Ohio, of the A. M. Byers Company, Pittsburgh. At the bottom the stack is 14 ft. inside diameter, tapering in 45 ft. to 8 ft. $\frac{3}{4}$ in. in diameter and continuing at this diameter for 180 ft., or a total height of 225 ft. It is provided with a coping ring on top for keeping the moisture off the brick lining, also with a ladder and safety cage of such construction that the workman climbs between the ladder and the stack. In other words, there is a bar frame work extending from the ladder to the stack, creating a cage; ordinarily, there is a space between the ladder and the stack, and the safety cage is on the outside of the ladder.

The 16 foundation bolts are 3 in. in diameter, and they extend through a U-shaped bracket forged from one solid piece of $\frac{5}{8}$ -in. plate. These brackets are 4 ft. high. The stack was built by the Sharpsville Boiler Works Company, Sharpsville, Pa.

CONVENTION ANNOUNCED

The twenty-fifth annual meeting of the American Society for Testing Materials will be held on June 26-July 1, 1922, at Atlantic City, N. J., with headquarters at Chalfonte-Heddon Hall Hotel.



Steel Works Power Plant Management

Permanent Statistics for the Power Plant—Pocket Note Book
Records Should Be Destroyed and Statistics Kept in a Permanent
Way.

By ROBERT JUNE, Mechanical Engineer

COMPLETE permanent specifications of equipment, properly filed, are not found in as many modern power plants as they should be. This is due rather to some neglect or lack of knowledge of how to proceed to keep these statistics in good shape rather than to lack of appreciation of their importance. It is indeed unusual to find the plant in which the operating engineers do not have some statistics written down in their pocket note books. Every one will agree that the pocket note book is not the place for this data. It should be kept in a formal manner and the records should be available at all times regardless of changing plant personnel.

The keeping of accurate specifications of equipment installed, greatly facilitates the making of repairs. It is of great value when the new engineer comes on the job, and it has a very important function in the adjustment of fire losses, should such occur.

The presentation of specifications of equipment not only serves as an accurate inventory of the contents of the plant but strengthens the case for the owner and is particularly valuable when the owner has gone to considerable expense to maintain old equipment lost in a fire. Moreover, in the event of a fire, such of the old equipment as it is desirable to replace, can be ordered without an instant's loss of time. The completeness of the specifications should increase with the value of the investment in the plant.

Power Plant Building.

Figure I indicates the desired specification data on the power plant building. This form is, of course, subject to some modifications, depending on the individual structure. However, all of the information contained in this form should be filed in ordinary cases, and if the building is large, additional information will suggest itself.

This information is, of course, of great value in connection with the plan of new buildings and additions, and is also of value to the accounting department in setting up depreciation reserves.

As an illustration of the value of these records, let us suppose that we want to construct an additional

building. The specification data tells us where we can match the cut stone or terra cotta trim of the original building. If new equipment is to be installed, we can tell by immediate reference to this sheet what the permissible floor load is. If any of the materials of construction, such as roofing, becomes defective, we can readily tell who the manufacturers were and ascertain at once whether a guarantee has been made to cover the life of this particular part. If we get unusually good service out of flooring, painting or roofing, and wish to use the same specifications in another building, we can get the data from this sheet.

Figure I.

POWER PLANT BUILDING DATA.

Dimensions—
Length..... Width..... Height.....
Type of construction—
Steel, concrete, wood, combination.....
Name of general contractor.....
Name of excavating contractor.....
Foundation down to elev.....
Kind of soil with permissible load.....
Floor loads permissible—
Engine room..... Basement.....
Boiler room.....
Masonry contractors
Cu. yd. of concrete and proportion used—
Foundation Yd. prop.....
Walls..... Floors.....
Structural Steel fabricated by.....
Lb. of steel—Reinforcing..... Structural.....
Common brick..... M.
Face brick..... M. Manufactured by.....
Enameled brick..... M. Manufactured by.....
Cut stone..... cu. ft. Manufactured by.....
from..... Quarry.
Sash—Wood..... Steel.....
Manufactured by.....
Terra cotta cu. ft..... Type of roof.....
Guarantee..... Manufactured by.....
Ventilators..... Manufactured by.....
Lighting type..... Manufactured by.....

Plumbing and heating..... Installed by.....
 Glazing..... Installed by.....
 Painting..... Installed by.....
 Floor preservative..... Done by.....
 Guarantee..... Manufactured by.....
 Completed..... Total cost.....

Boiler Data.

The boiler room is often the heart of the entire plant. If something goes wrong with the boiler, it affects progress in all departments. We need to have complete information regarding the boilers available at all times. True, we usually have blueprints, or ought to have them. The actual installation, in some instances, may vary from the blueprints, but there is a certain amount of information regarding the boilers to be obtained from the specifications furnished by the manufacturers. It is possible to put all this information in one place and on a single sheet, Fig. II.

Figure II.

BOILER DATA.

Plant No..... Builders No.....
 Location

Manufactured by.....
 Factory address.....
 Nearest office address.....
 Man to call regarding repairs.....
 Phone..... Date installed.....
 By whom

Type..... Weight boiler..... Weight water.....
 Tubes, No..... Diameter..... Length.....
 Made of..... Steam pressure gauge.....
 Safety valve—
 Pressure..... Type..... Diameter..... Number.....
 Steam space, sq. ft..... Water space, cu. ft.....
 Heating surface, sq. ft..... Superheating surface, sq. ft.....
 Area of grate..... Type of grate or stoker.....
 Rated horsepower

Ratio of heating surface to grate area.....
 No. of steam drums..... Dia. of steam drums, in.....
 Thickness of shell, in..... Thickness of head, in.....
 Type of joints..... Dia. of steam nozzle in.....
 Dia. of blowoff, in..... Dia. of feed pipe, in.....
 Temperature of feed water..... Type draft.....
 Maximum draft..... Height of setting.....
 Length of setting..... Thickness of walls.....
 No. of fire brick..... No. of common brick.....
 Distance between batteries.....
 Distance from back of boiler to wall.....
 Distance from front of boiler to wall.....
 Manufacturer's guarantee

Combined boiler efficiency—
 100% rating..... 200% rating..... 300% rating.....

Economizer Data.

If economizers are installed in connection with our boilers, we want the data concerning them to be as readily available as that of the boilers. If economizers are equipped with scrapers, there is frequent need to make replacements, and we also want the manufacturers to guarantee this equipment for us so that we can check up the performance of the equipment. Figure III gives this essential information.

Figure III.

ECONOMIZER DATA

Plant No..... Builders No.....
 Location

Manufactured by.....

Factory address.....
 Nearest office address.....
 Man to call regarding repairs.....
 Phone..... Date installed.....
 By whom

Type..... Weight economizer..... Weight water.....
 Tubes, No..... Diameter..... Length..... Made of.....
 Heating surface per sq. ft. boiler heating surface, sq. ft.....
 Heating surface per boiler horsepower (34.5 lb. water per hr.)
 rated capacity, sq. ft.....

Cleaning: If by scrapers.
 Type motor..... H. P..... A.C. or D.C..... Voltage.....
 R.P.M..... Make motor.....
 From whom purchased.....
 Name and address to call regarding repairs.....

Cleaning: If by mechanical soot blowers.

Make of soot blower..... Type.....
 No. of units..... Size riser pipe..... Size header.....
 Make and size of valves.....
 Name and address to call regarding repairs.....

Manufacturer's guarantee:
 Feed water lbs. per hr..... Temperature
 leaving economizer when entering at 180 deg. F.....
 Gas temperature entering deg. F.....
 Gas temperature leaving deg. F.....
 Gas temperature difference.....

Soot Blower Data.

The economical soot blower insures high boiler efficiency and they save fuel. They are an essential part of our equipment and it is extremely important that we should keep the blowers in the best operating conditions at all times. A sheet made out in accordance with Figure IV gives us all of the essential data on this important piece of equipment.

Figure IV.

SOOT BLOWER DATA.

Boiler No.
 Location

Manufactured by.....
 Factory address.....
 Nearest office address.....
 Man to call regarding repairs.....
 Phone..... Date installed.....
 By whom.....

Type..... Trade name.....
 Number of calorized units.....
 Number of plain units.....
 Diameter of header.....
 Diameter of risers.....
 Diameter of drains.....
 Location of units (see blue prints).....
 Diameter of nozzles.....
 Type of nozzles.....
 Make of main valve.....
 Make of individual valves.....

Condenser Data.

In Figure V we have a typical figure to keep our condenser statistics. Here we have all the necessary data on length, diameter, and thickness of tubes, data on circulating, dry vacuum and hot well pumps, capacity of the condenser, etc. This information is of great value to the operating force.

Figure V.

CONDENSER DATA.

Plant No..... Building No.....
 Location

Manufactured by.....
 Factory address.....
 Nearest office address.....
 Man to call regarding repairs.....
 Phone..... Date installed.....
 By whom.....
 Type..... Weight condenser.....
 Weight water..... Tubes, No..... O.
 Diameter..... Thickness..... Length.....
 Made of..... Cap. lb. steam per hr.
 at..... in. vac. and cooling water at..... deg. F.
 Steam condensed per sq. ft. of surface, lb.....
 Total tube surface per condenser, sq. ft.....
 Manufacturer's guarantee:—With..... gal. 70 deg ctr.
 water, vacuum in condenser..... in.
 Hot well temperature..... Cross sectional area
 intake tunnel..... sq. ft..... Discharge tunnel..... sq. ft.
 Circulating pumps:—Type.....
 Manufactured by.....
 Address.....
 Size..... Capacity, gal. per minute.....
 Circ. water pumping cap. per lb. of steam condensed at con-
 sumption of..... lbs. Per Kw. Hr. Lbs.....
 Cooling water per lb. of steam at full load, lb.....
 Screens at circulating water intake, type.....
 Dry Vacuum Pump:—Type.....
 Manufactured by.....
 Address.....
 Size..... Capacity.....
 Hot Well Pump:—Type.....
 Manufactured by.....
 Address.....
 Size..... Capacity gal. per minute.....
 Remarks.....

Feed Pump Data.

In filling out our feed pump statistical data sheet, Figure VI, we should tell whether the feed pumps are centrifugal, reciprocating or rotary, and should give the diameters and sizes of the main parts. In connection not only with the feed pump data but with the data of other types of equipment, it would be well to maintain a file of catalogues, and particularly of spare parts catalogues.

Figure VI.

FEED PUMP DATA.

Plant No..... Building No.....
 Location.....
 Manufactured by.....
 Factory address.....
 Man to call regarding repairs.....
 Phone..... Date installed.....
 By whom.....
 Type..... Weight..... Stroke.....
 Diameter of steam cylinder.....
 Diameter of water cylinder.....
 Displacement per stroke, cu. ft.....
 Number of strokes per minute, average.....
 Steam pressure, per lb..... Back pressure, per lb.....
 Number of valves..... Type of valves.....
 Pounds of water per 24-hr. average, actual.....
 Dia. of suction..... Dia. of steam discharge.....
 Dia. of steam pipe..... Dia. of exhaust.....
 Dia. of steam drips.....
 Piston Packing..... Size.....
 Rod Packing..... Size.....
 Temperature of feed water deg. F.....
 Suction head, lb. per sq. in.....
 Discharge head, lb. per sq. in.....

Remarks:

Chimney Data.

As the chimney is not a complicated proposition, we do not need to record as much information regarding it, but there are a number of points which should be noted and filed. These are covered in Figure VII.

Figure VII.

CHIMNEY DATA.

Plant No..... Building No.....
 Location.....
 Manufactured by.....
 Factory address.....
 Man to call regarding repairs.....
 Phone..... Date installed.....
 By whom.....
 Type..... Weight..... tons
 Construction material data.....
 No. of boilers served.....
 Stack area per 1,000 sq. ft. of boiler heating surface..... sq. ft.
 Height above grate, ft..... Size at breeching.....
 Diameter at top.....
 Amounts of material used.....
 Common bricks, No. of..... M.
 Fire bricks, No. of..... M.
 Yards of concrete..... Reinforcing steel.....
 Sheet steel.....
 Remarks:

Turbine Data.

Turbine data covers the capacity, operating conditions, performance guarantees, etc. It is a very good thing to have this information constantly before the operating men as they are much keener to check up results with actual records. (Figure VIII.)

Figure VIII.

TURBINE DATA.

Plant No..... Building No.....
 Location.....
 Manufactured by.....
 Factory address.....
 Man to call regarding repairs.....
 Phone..... Date installed.....
 By whom.....
 Type..... Weight..... R.P.M.....
 Heaviest piece to be lifted by crane..... tons
 Operating pressure..... Operating superheat, deg. F.....
 Exciters, No..... Capacity each, Kw.....
 Types..... Manufactured by.....
 Main unit cap. per kw. cap. of exciters installed, kw.....
 Performance guarantee—Operating condition:
 Lb. press. abs..... Deg. F. superheat.....
 In. vac. condenser..... In. barometer.....
 Net kw. load of generator.....
 Lb. of steam per kw. hr.....
 For different pressures and deg. above or below normal tem-
 peratures following factors to be used..... % for
 each 15 lb. press. for range of 25 lb. above or below normal.
 Blade data.....
 Remarks:

Method of Filing.

The forms outlined herein should properly be made out in duplicate, one copy on file in the superintendent's office, or in the main office, and one in the power plant. They can well be made out on type written sheets, placed in loose leaf record books. The forms given cover the principal equipment. Forms will suggest themselves for the minor items of equipment and these

can be made out, using the forms given herein as a guide.

If an engineer has before him complete information of all details of the equipment which he is handling, he is encouraged to keep close watch over performances. The forms can be very easily made to suit the particular conditions of any given plant and they can very easily be filled out.

Firing Boilers With Fuel Oil

Indications Point to the Fact That Fuel Oil Will Be Used to a Greater Extent Than Ever Before in the Firing of Boilers—Oil Market One of Advantage at Present.

EVERY fuel has some particular field in which its use predominates. In practically every case the reason for this is to be found in low cost. Again, low cost prevails because of advantageous freight rates. Exceptions exist where some particular process requires some other fuel more suitable physically or chemically. Again, competition may arise, due to fluctuations in demand for some one of our several fuels. There is probably no better illustration of the truth of the above statements than is accorded by the fuel oil market during recent years.

On the Pacific coast and to a lesser degree on the Atlantic, petroleum enjoys wide popularity due to the fact that it can be purchased at a comparatively low figure. The oil fields of California afford a supply for the western coast, while the Mexican and Gulf fields are made accessible by water shipment to the eastern coast.

During the war the demand for fuel oil for ships increased tremendously due to apparent advantages this fuel possesses as a war-time fuel for vessels. For this reason the demands on land were made subservient to those on sea. During this period it was almost impossible to obtain a contract for oil. Today conditions are the reverse, with strong indications of a decided slackening in demand for oil for seagoing vessels. The scrapping of so many warships with a ten years' vacation in construction will be a further impetus towards lessening the demand.

With prospects of an increased supply of petroleum for use on land, greater interest will naturally be aroused in this fuel, especially for heating boilers. Aside from boilers, the greatest demand is from metallurgical furnaces, the majority of which are of small size and in which other fuels are not economical due to physical characteristics.

Fuel oil possesses the following advantages:

- 1—Economy of space. One cubic foot of oil at 26 Baume weighs 55.9 pounds and will contain about 19,000 Btu. per pound.
- 2—Can be readily handled due to it being a liquid.
- 3—Requires a small crew to handle boilers and furnaces.
- 4—Elimination of ashes.

The above are the principal advantageous features.

It will be observed that the advantages noted above are those which apply not only to vessels, but also to plants, such as office buildings, where there is restricted space and where ground is valuable. Fuel oil, therefore, has a special field in plants located in large cities or in places where there is little room for equipment. Where such limitations do not exist, the advantages of oil are less apparent, unless the cost is greatly in its favor.

In addition to the four features named above, there are others of minor importance and which are not exclusive to oil. Powdered coal, for instance, as well as oil, possesses these advantages:

- 1—Elimination of smoke. This is particularly desirable in a city where the restrictions on smoke are strictly enforced. Cooler boiler room.
- 2—Saving in labor.
- 3—High furnace efficiency.
- 4—Control of fire simplified.

The actual firing of boilers with fuel oil presents some very interesting problems which are at times difficult to solve. These have to do generally with the control of the air and design of the furnace. In many cases plants which have burned coal on grates are changed so that oil can be substituted. In two plants recently visited, one formerly burned anthracite coal while another had been stoker fired. Oil firing and coal firing are entirely different and in each of the plants mentioned they had considerable difficulty obtaining smooth working conditions.

Comparison between oil and coal can all be reduced to two factors—comparative cost and plant location. For boilers, in most localities, coal is the cheaper, but in some districts oil competes with coal at certain times. In such districts the boilers are equipped so that oil or coal can be burned depending on which presents the greater advantage on a cost basis. The price of oil has been so uncertain in recent years that most plants are compelled to equip their boilers so that they can change to another fuel quickly. A large equipment company has placed stokers on their boilers and oil burners in the rear. This plant can change from oil to coal in one hours' time. What advantages oil possesses over coal outside of cost lie in the fact that it is a liquid and has a high heat value per pound. The actual performance

of a boiler burning oil, day by day, can be rated as little if any better than coal.

The information which follows has been gathered from representative plants which have been burning oil under their boilers for some years. Two types of burners were investigated. These were both of the type known as "outside mixing." The atomizing agent was steam.

The choice of burner will depend on conditions obtaining at the plant in question.

Where boiler feed water is of vital importance as on vessels, the high pressure mechanical burner is to be preferred as no steam is used for atomizing and none lost up the stack. These burners require an oil of low viscosity. Heavy Mexican oil for use in a mechanical burner should be heated to 250 deg. F. or higher. The pressure at the burner will be on an average of about 200 pounds. To secure this temperature and pressure of oil, steam must be used, but it will be returned to the condenser and hence is not lost. This steam will amount to approximately 2 per cent to 3 per cent of the total feed water fed to the boilers. This percentage will, of course, vary, depending on the particular conditions at the plant. Where such high pressures are maintained the piping must be such as to leave no question of security. This is further enhanced by installing an automatic stop valve which automatically shuts off the oil supply, should a break in the line occur.

On land, the majority of burners are those which atomize the oil by steam. Representative burners of this type are the Hammel and Best. The steam should be dry and at a boiler pressure of 100 pounds or higher. The oil burned under a 500-hp. boiler in a large office building was heated to 146 deg. and was at a pressure of 40 pounds. This was Mexican oil. Lighter oils obtained in the United States need not be heated if they are at about 26 Baume.

The oil should be atomized to an exceedingly fine mist in order that it may be gasified readily. All that any of the so-called burners can do is to break the oil up and discharge it into the furnace so that it can easily be gasified. The oil will be gasified by heat and it is this gas which must be mixed with air. Unless this is the case combustion will not be efficient. This point may be brought out more clearly by considering the composition of oil and the manner in which it burns. All oils are composed of liquid hydrocarbons whose exact chemical structure is not readily determined. The burner—or more correctly the atomizer—breaks up the liquid only. The fine liquid mist is gasified by heat and the hydrocarbons broken up into their elements—hydrogen and carbon. The hydrogen and carbon burn to water and carbon dioxide if combustion is complete. If not complete there would be free hydrogen and carbon or carbon monoxide. It is the hydrogen and carbon then which must find their necessary quota of oxygen, which of course comes from the air. The air then must be thoroughly mixed with the gaseous hydrocarbons as they break up into their constituents. It is not enough that the air and liquid hydrocarbons be mixed, but the further step as outlined must be accomplished. The lack of such a condition produces carbon as soot. This is not the only manner in which soot may be produced, but it is one of them.

Many different furnace designs have been tried out with the intention of securing correct combustion. In one of the furnaces in a large steel plant the floor of the furnace is perforated and air is drawn in through

these perforations. In another boiler plant the air is induced by the burner, aided by the draft created by the stack. The floor here is solid and all air enters around the burner.

A feature of great concern is the regulation of the air in proper proportion to the oil. This is done by appropriate mechanism or by hand. It requires far less draft for a boiler burning oil than for one burning coal. In the oil fuel furnace there is no fuel bed through which the air must be drawn. Therefore in a plant where oil is substituted for coal there will be a tendency to carry too strong a draft unless precautions are taken to check up the excess air. A smoky flame will indicate an insufficient air supply, but excess air is not apparent to the eye. In the office building previously mentioned, the CO_2 varied from 13 per cent to 15 per cent. The draft over the burners was .1 inch. Where the CO_2 is carried too high there is a chance that CO may be present in the gases and instead of a high efficiency it may actually be lowered.

The flame in the boiler should be so controlled that combustion will be complete before it strikes the cold tubes. Otherwise the carbon will not be burned, but will appear on the tubes as soot. This can be cleaned off with a lance or by soot blowers. The direction of the flame on leaving the burners should be such that there is no contact with the floor of the combustion chamber nor with the tubes.

Tests made show that efficiencies of from 75 per cent to 82 per cent can be obtained, but over a long period efficiencies of 80 per cent to 82 per cent are not common. In a series of tests made recently, the lowest was 76 per cent, while the highest was 83 per cent. The boilers were 500-hp. Babcock & Wilcox. The capacity ran from normal to 181 per cent.

The amount of water evaporated per pound of oil will average from 12 to 14 pounds. The highest evaporation on the test was 15.85 pounds, at which rate the evaporation from and at 212 deg. per square foot of heating surface was 3.90 pounds. The highest evaporation per square foot of heating surface was 5.75 pounds.

In electric lighting plants comparison is usually made from day to day in terms of kilowatt hours per barrel of oil. Running with a light load, 122 kw. hours were obtained in daily operation. With a heavy load, this figure would be materially bettered. Two hundred kw. hours have been secured per barrel of oil.

As is the case in all plants where fuel of any kind is burned, the really important factor is the personnel. Expressed in plainer terms, the supervision of the actual burning of the oil determines the results. In this connection the results achieved have not always been what they should be due to the fact that the operators did not understand the proper handling of the oil burning equipment. The phenomena attending the combustion of oil are not as apparent to the eye as is the case with coal. For this reason all boiler plants burning oil should be equipped with a full set of instruments as only by these instruments can the attendant check his observations. In starting a plant, expert supervision will be required until the attendants have had time to thoroughly familiarize themselves with the equipment.

The answer to any problem such as that discussed will be found in the cost sheet. Therefore, all factors having any bearing on the relative merits of oil and coal should be fully investigated.

The supply of coal is practically assured while, judging from past experience, there is not the same assurance in regard to oil.

Development of Rolling Mill Engines

The Gas Engine Is Not a Good Type of Engine for Rolling Mill Work—However, the Combination of a Gas Engine with a Steam Engine Has a Decided Advantage.

By F. J. DENK.

THE development of the rolling mill engine has followed the same course, as that of the other steam engines. Starting out with the single cylinder engine, the way led to the compound engine and, for flywheel drives, to the triple expansion engine. The reason for this development was, that the steam consumption had to be kept, for economical reasons, as low as possible, and single cylinder engines could, at the early times, not be classed among the economical steam users. With the introduction of the compound engine, naturally, the disadvantages, adherent to this type of steam motors, had to be taken into account. In the first place, the construction and design of a compound engine is more complicated and, therefore, more expensive, than that of a single engine. Cost for repairs and maintenance is much higher. The high pressure cylinder of a compound engine works, at normal load, with a higher cut-off, than that of a single cylinder engine, and the danger arises, that, at sudden large increases of the load, the multiple compound engine cannot overcome the peak and will stop dead. Another disadvantage, connected with the operation of a compound engine, is due to the fact, that, as soon as the ingots enter the rolls, the high pressure cylinder has to take care of the full load, whereas the work done by the low pressure cylinder lags behind. Only after a number of revolutions have passed, the receiver pressure will be big enough to make the low pressure cylinder take up the larger part of the work, which it should always do. But, for the first few passes, the time, during which the ingot will be between the rolls, will be so short, that the ingot will have left the rolls, before the low pressure cylinder had time, to take up its share of the work, and, in this respect, the compound engine is not as good as the single cylinder engine, where every increase in the load is taken care of by a corresponding increase of the work done by the engine. This was one of the reasons why single cylinder engines have held their position in the rolling mill industry, because simplicity in construction, economy in steam and oil consumption and perfect adaptability to prevailing load conditions are points, which cannot and should not be overlooked.

The following table shows the steam consumption and the percentage of work developed, used for rolling, for different types of mill engines. For comparison's sake data for an electrical drive are also given.

Type.	Lbs. Steam/I HP-hr.	% of Work Consumed in Rolling.
Three-high,	22	82
Twin tandem compound, condensing, geared,	35	80
Twin single cylinder, non- condensing, geared,	45	75

Twin tandem, compound, condensing,	35	65
Twin tandem compound, non-condensing,	50	57
Electric,	..	74

The data are taken from average American and European practice and show, in a general way, the performance of the different types of rolling mill drives. A decided difference in the percentage of the work consumed for rolling can be noticed. The reciprocating engines, of course, are at the top of the row with a useful work of 82 per cent, because the flywheel engine does not have any losses for accelerating the revolving masses. The twin tandem compound drives show a wide range in the percentage of useful work, viz.: 80 per cent, 65 per cent and 57 per cent. The first figure comes from a geared engine with a gear ratio of 1:2.5. This alone is enough to account for the large percentage, as the reduction in power required is proportional to the square of that gear ratio, or, in the present case to 1:6.25. Besides, this engine is a European design, which, as a rule, are built lighter than our American engines.

The table shows furthermore, that the single cylinder engine has a higher percentage of useful work, than the twin tandem compound engines, mentioned above. The engine in question is geared, but the gear ratio is so near unity (about 1:1¼), that most of the difference must be ascribed to the reasons given above as adhering to the construction design and operation of the compound engines.

The electrical drive does 74 per cent of useful work, the rest is consumed in acceleration losses (9 per cent), friction losses (11.5 per cent) and copper losses (2.5 per cent).

European practice (*) has turned to some new types for driving rolling mills, although it must be said, that American engine manufacturers have directed their attention in the same direction, at least to a certain extent.

The single cylinder steam engine has been developed as a uni-flow engine with a short piston and with the exhaust ports in the middle of the cylinder. The compression in this type of engine amounts to about 60 per cent; it is, therefore, still comparatively high. During expansion the exhaust ports are kept closed by means of a valve located behind them. About 10 per cent before the dead point, the valve opens and the steam is exhausted. The arrangement as described is a disadvantage connected with this type of uni-flow engines, as far as rolling mill work is concerned, because here it is imperative, that, when working with

*Stahl und Eisen, Vol. 41, No. 46, p. 1649 FF.

large cut-offs, the large quantities of steam must have a chance to escape unthrottled, thus equalizing completely the pressure in the cylinder and in the condenser.

Several other types of uni-flow engines have been developed, which are improvements over the designs of the older types, whereby it was kept in mind, that one of the most important parts of a single cylinder rolling mill engine is the arrangement and the working of the exhaust valves, in order to enable them to discharge easily and effectively the large quantities of steam which are required by the engine whenever sudden peak loads occur.

Steam economy can also be effected by a well and efficiently working condenser. A vacuum of 3 to 4 in. Hg is very good, but it will hardly be obtained in regular practice; 8 to 10 in. Hg can easily be reached, but in most cases the vacuum will stay below this figure.

In order to obtain the highest possible economy with a non-condensing engine, the exhaust steam should be used for heating and similar purposes. In case this cannot be done, the best uni-flow engine will suffer under the same disadvantage, adherent to every steam engine of the non-condensing type, that is, its very low thermal efficiency.

This has been one of the reasons, why it has been tried to replace the steam engine by the gas engine; it has also caused a big advance in the application of electrical drives, the motors of which are supplied with current from a central station which can, in the case in question, work with a higher efficiency than a steam plant.

The internal combustion engine is far superior to the steam engine in blast furnace and coke oven plants, where the power gas is at hand and would otherwise be wasted either entirely or to a large extent. But as a rolling mill drive a gas engine is inferior to the steam engine, because it can only carry a very small percentage of overload, thus forcing the mill superintendent to install units which are by far larger than his ordinary power requirements demand. The gas engine must, therefore, be designed for a capacity from 50 to 80 per cent higher than necessary, and this, in turn, is followed by the further disadvantage, that the heat consumption increases, when the load decreases, thus reducing the superiority of the gas engine over the steam engine considerably, as far as thermal efficiency is concerned.

The operation of the gas engine is also not without fault, because ignition may set out, and if this happens several times in succession at full load, the engine will stop. For all these reasons, the gas engine has not made very much headway as a rolling mill drive. But it can be shown, how a combination of a steam engine with a gas engine, forming one driving unit, may be used to advantage.

In such a case, the gas engine will have to take care of the regular average load, whereas the steam engine has to overcome the peak loads. Needless to say, that the load variations, which the steam engine will have to take care of, are greater in this case, than with the pure steam drive. The steam engine must, therefore, be designed in such a way, that it is capable to take care of all these variations with the highest possible thermal efficiency. This condition is best filled by the uni-flow type of steam engines. Tests made under the same working conditions have shown, that a uni-flow

engine has 12 per cent efficiency, the gas engine 14 per cent and the combined steam-gas unit 17 per cent. The saving in fuel of the gas engine over the steam engine amounted to 14 per cent, and that of the combined steam-gas unit over the steam engine to 29 per cent.

The design of the steam-gas unit can be made in such a way that the steam cylinder is in front and the two 4-cycle gas cylinders in the back, all in the same axis and all three working on the same crank. Simpler, however, is the arrangement as a twin engine, one side being formed by the gas engine and the other by the uni-flow engine. The most compact design is represented by a horizontal-vertical outfit, the steam engine being the vertical part, located in the axis of the horizontal gas engine and both working on the same crank pin. The two last named designs have the advantage, that the gas engine can be cut out entirely, if necessary.

Conclusion.

The percentage of useful work done in rolling is shown for different types of steam driven rolling mill engines. It is furthermore shown, that a gas engine is not a good type of engine for rolling mill work, but that the combination of a gas engine with a steam engine will have decided advantages over either one of the pure drives. Different arrangements of such a combined steam-gas unit are described.

THE STUDY OF MOLYBDENUM ORES

The United States possesses the largest known deposits of molybdenum ores, but is relatively poor in high-grade deposits of some other important alloying elements used in alloy structural steels, such as automobile steels, says the Federal Bureau of Mines. Nickel, chromium and vanadium are the standbys in present-day alloy steels. Of these we have very little nickel, some chromium, mostly in relatively low grade ores, and only small deposits of vanadium. It is of utmost importance to know to what extent molybdenum can replace any of these elements. Moreover, there is as yet comparatively little market for molybdenum.

According to tests made by H. C. Chandler and C. H. Willis, given wide publicity by producers of molybdenum, that element as an alloying material ranks with nickel, chromium and vanadium in preparing steel of high quality. Molybdenum steels found some use during the war, but their production thereafter almost ceased.

In order to corroborate the published tests, to extend them, and to study in detail the shock and fatigue-resisting properties of molybdenum steels, a co-operative agreement was entered into by the Bureau of Mines with the Vanadium Corporation of America, producers of molybdenum, by which the services of R. J. Thompson, metallographer, were made available. The co-operation of the Wymann-Gordon Company, Worcester, Mass., was enlisted in making impact and repeated-impact tests.

A comprehensive series of molybdenum steels and of other steels for comparison has been made in the electric-furnace laboratory of the department of chemistry at Cornell University and rolled at the Halcomb Steel Company plant and test bars were machined, heat treated, and given tensile and fatigue tests in the shops and laboratories of the Sibley School of Mechanical Engineering at Cornell University.

NEWS OF THE PLANTS

The Slatington Iron & Steel Company, Slatington, Pa., recently incorporated with a capital of \$105,000,000, under Delaware laws, is arranging details for the construction of a new steel manufacturing plant in the vicinity of Birmingham, Ala., on site recently acquired. Notice has been filed with the state of organization and intention to build. The initial unit is estimated to cost in excess of \$500,000, and will comprise a number of mills. The company will also construct a blast furnace at a later date. Iron and coal properties have been acquired in Etowah County, Ala., consisting of about 10,000 acres of land, and these will be developed. A complete iron ore plant will be installed on the site. John W. Baker, 711 Lumber Exchange Building, Chicago, Ill., is one of the principals of the company.

The Lafollette Coal & Iron Company, Lafollette, Tenn., has preliminary plans in progress for the construction of a by-products coke plant, to be used for the carbonizing of fuel and other service at the local mills. The plant will have a monthly output of about 13,000 tons. It is estimated to cost about \$500,000, including machinery and equipment. Parker & Wilder, Cincinnati, Ohio, are engineers for the company in charge of the project.

The Lorain Steel Company, Johnstown, Pa., has construction under way on a new electric steel foundry at its local works, and plans to place the plant in operation at an early date. A 4-ton electric furnace will be installed.

The Wickwire-Spencer Steel Company, Buffalo, N. Y., has increased operations at its local finishing mill to full capacity under regular working hour schedule.

The Duluth-Globe Iron Works, First and Hughitt avenues, Superior, Wis., has plans under way for the construction of a one-story addition to its plant at Duluth, Minn. It will be 125x130 feet, located on Michigan street.

The Hudson City Steel Company, 233 Broadway, New York, N. Y., has preliminary plans under consideration for the construction of a new steel plant at Hudson, N. Y., to consist of a group of buildings. It is proposed to commence construction early in the spring. Dwight P. Robinson & Company, 125 East Forty-sixth street, New York, are engineers.

The Slatington Iron & Steel Company, Slatington, Pa., is making a number of improvements at its plant, including repairs to machinery, and plans to resume operations at an early date. The works have been closed down for a number of months past. Robert Grant, Woodworth Building, New York, heads the company.

The Bethlehem Steel Corporation, Bethlehem, Pa., has improvement work under way at its works at Lebanon, Pa., including the construction of an addition to the concentrating and sintering plant, and improvements in the galvanizing department. Extensions will also be made in the pickling department as well as in the wire-treating shop. The company is also constructing an addition to the 28-inch billet mill at its main works at Bethlehem.

The Builders' Iron & Steel Company, Bridge street, Cambridge, Mass., has awarded a contract for the construction of a

new plant on Garvey street, Everett, Mass., to comprise a modern iron and steel works. It will be 70x250 feet, and additional units, it is understood, will be erected at a later date. The initial plant will cost approximately \$75,000. Howard P. Farmer is president of the company. Blake & Pope, 15 Beacon street, Boston, Mass., are building contractors.

The Charcoal Iron Company, Detroit, Mich., is making a number of improvements at its iron ore works in the Manistique, Mich., district. The plant will be placed in operation immediately. The company has increased production at its iron ore properties at Bessemer, Mich., and a day and night shift are working under regular schedule.

The Richmond Car Works, Richmond, Va., recently organized under state laws with a capital of \$500,000, has acquired the government plant at South Richmond, originally designed for a marine boiler works, but never occupied. The plant covers a large tract of land and consists of a number of buildings. It will be equipped and used by the new company for the manufacture of architectural steel and iron products and affiliated specialties, as well as railway and other cars. The main building is 180x600 feet. The plant was acquired for a consideration in excess of \$200,000. Lewis C. Williams is president.

The Bethlehem Shipbuilding Corporation, San Francisco, Cal., a subsidiary of the Bethlehem Steel Corporation, Bethlehem, Pa., has acquired the plant of the Southwestern Shipbuilding Company at Los Angeles, Cal., and will convert a portion of the plant into a steel fabricating works for the manufacture of structural shapes for building and other service.

The Wheeling Steel Corporation, Wheeling, W. Va., has plans in progress for the construction of a number of additions to its LaBelle Iron Works plant, Steubenville, Ohio. The work will consist of a new reversing blooming mill, to be provided with heavy shears, tables, transfers and affiliated equipment. Other work is also contemplated.

The American Steel & Wire Company, Worcester, Mass., a subsidiary of the United States Steel Corporation, New York, is perfecting plans for the construction of the proposed additions to its plant for increased production. The first structure to be erected, and plans for which have been completed, will be 60x900 feet, located at the North Works, and will be used primarily for galvanizing operations. Extensive electrically-operated equipment will be installed. The plant will cost about \$50,000. The Engineering Department at the works, under the direction of Charles E. Goodrich, chief engineer, has plans in progress for other additions to be made at the plant, estimated to cost about \$275,000. Work will be placed under way at an early date.

The Chicago Bridge & Iron Works, Chicago, Ill., is increasing production at its steel fabricating plant at Greenville, Pa., and a night shift has been added to the working force.

The Mansfield Sheet & Tin Plate Company, Mansfield, Ohio, is proceeding with construction work on a number of plant additions, and proposes to have the units ready for service at an early date. The expansion will comprise four 80-ton open hearth furnaces, with new blooming mill and sheet bar mill, the latter to be equipped to handle material, 24-inch.

PRODUCTION TOPICS

The work of the Bureau of Mines on iron ores is directed chiefly toward devising means for utilizing extensive deposits of low grade ores that cannot be smelted profitably by present methods. In order to utilize such ores, it is necessary that enough of the gangue and impurities be removed to raise the ore to smelting grade, or methods of smelting ore of lower iron content must be devised.

The North Central mining experiment station of the Bureau of Mines, at Minneapolis, Minn., has continued to co-operate with the state mining experiment station in an investigation of the reserves of low-grade ore in the Lake Superior district, and in milling tests of samples collected in the course of the field work. This work has also included experimental tests of low-grade iron ores in the southern districts. With the establishment of the mining experiment station at Birmingham, Ala., more extensive work has been made possible, and a comprehensive survey of the iron and steel industry of the Birmingham district has begun. The main object sought is to develop means of beneficiating the low-grade highly silicious ores that occur in large quantities in that district. At Minneapolis, the work has been more closely related to utilizing low-grade manganese iron ores of the Lake Superior district, particularly as regards the study of blast furnace practice, and the operation of the experimental blast furnace at that station.

The investigation of the heat treatment of drill steels has been continued by the Bureau of Mines, and the scope of the work greatly extended. The breakage of drill bits in use constitutes an important part of mining costs, and the object of this work is to determine the causes of breakage and to find means for their elimination.

The Mississippi Valley experiment station, which has its headquarters for field work at St. Louis, Mo., and its laboratories at Rolla, Mo., is co-operating with the Minneapolis station in the investigations of drill steels.

In the course of the rock-drilling and drill-steel investigation in the Tri-State district, work has been started to find out the most efficient change of gauge to use between different lengths of steel. Present practice favors changes of from one-fourth to three-sixteenths of an inch, but it is planned to try changes as small as one-sixteenth inch. A reduction in gauge means decreased drilling cost, as the work of drilling varies with the size of the hole. It is also planned to try out smaller sizes of drill steel. The size of drill steel now in use in this district is 1¼-inch round. In several other districts where the large size was formerly used the same work is being done with smaller steel, thus reducing the cost of the steel, lessening the work of the miner in transporting steel, and increasing the drilling speed. Steels 1 inch in diameter will be tried and results will be compared with tests with the larger steel. The results thus far indicate that the 1-inch steel can be used successfully and that a considerable saving in drilling cost will be effected.

The experimental blast furnace built at the Minneapolis station by P. H. Royster, assistant metallurgist, and T. L. Joseph, assistant metallurgist, was put in blast 12 times for the study of blast furnace reactions as related to low-grade manganese ore now available in the United States. Fundamental data were collected and used as a basis for future experiments. Experiments have been conducted on the flow of gases and the flow of stock in blast furnaces. Other subjects of investigation have included the following: Volatilization of manganese in the blast furnace; history of blast furnace lines, shapes, and

sizes; the rate of reduction of iron oxide by carbon monoxide gas; the production of high-silicon pig; charcoal iron furnace practice.

The Bureau of Mines station at Seattle has been engaged in making a general survey of the iron and steel situation in the Pacific coast states, with regard to consumption of iron and steel and the supply of raw materials for their manufacture. The results of this survey have indicated that a preliminary reduction of the iron ore to sponge iron, with subsequent melting in the electric furnace would be peculiarly fitted to the needs of the Pacific coast, and considerable progress has been made in experimental work in developing this method to a commercial basis.

A rapid and accurate method for the determination of metallic iron in sponge iron has been developed.

VOLATILIZATION OF LOW-GRADE AND COMPLEX ORES.

The application of the chloride-volatilization process to the recovery of metals in low-grade and complex ores continues to be one of the major problems being studied at the Intermountain Experiment Station of the Bureau of Mines at Salt Lake City, Utah. The process consists of crushing to the proper fineness; mixing with chloridizing agents, such as sodium and calcium chloride, alone or with other reagents; furnacing at elevated temperatures to effect chloridization and volatilization of the metal chlorides formed, and treatment of the volatilized chlorides to obtain the valuable metals in salable form. Electrical precipitation is the most feasible way of collecting the volatilized fume.

The station maintains a semicommercial plant that includes a large rotary kiln of the cement type, a Wedge roasting furnace and two electrical precipitators, each with a capacity of 1,500 cubic feet of gas per minute. The station's plant also includes a small rotary kiln in which preliminary testing is conducted before testing in the large kiln. A new type of furnace, in which the ore charge is introduced at the fire end, has been constructed. Results indicate that better extractions can be obtained than in other types of furnaces tried.

The treatment of the collected fume continues most important, as the fume from each ore is a problem in itself. A laboratory-size reverberatory furnace for the reduction of lead and copper chloride fumes has been constructed to determine whether continuous feed can be employed without excessive loss by volatilization. During test runs by the use of this furnace careful control of the temperatures, keeping them below 1,150 deg., eliminated much of the loss by volatilization. Investigations were made to determine the feasibility of introducing the metallic chloride fumes through the side of the furnace underneath the surface of the slag, and these experiments proved to be successful. The small-scale laboratory experiments indicate practically a complete reduction of lead and copper fumes.

The volatilization process is best suited for low-grade oxidized ores of copper, lead, silver and zinc, and also for the more complex oxidized ores of these metals. Practically complete extractions of lead and copper have been obtained, and the extraction of silver has been from 50 to 90 per cent. Copper ore carrying copper mainly in the form of Chrysocolla is very difficult to volatilize. The volatilization process seems to be particularly adapted to separating lead and zinc in oxidized ores.



Roland Gerry, a director of the Jones & Laughlin Steel Company and manager of sales of the cold-rolled department, has been advanced to the position of special sales representative of the company for the United States and Canada, effective February 1. Mr. Gerry will be succeeded by William B. Todd, at present vice president of the Union Drawn Steel Company, Beaver Falls, Pa. Mr. Gerry has been with the company 41 years, rising through the sales department in successive grades to the new responsible position he is about to occupy. Mr. Todd has been with the Union Drawn Steel Company for 20 years, having entered its employ through the mill office in 1901 and been advanced through various departments to the vice presidency.

O. H. Wharton, vice president in charge of sales and also a director of the Crucible Steel Company of America, has resigned.

Charles E. Stuart, secretary and treasurer, Central Steel Company, Massillon, Ohio, has been elected president of the Massillon Chamber of Commerce. Among other new officers of the chamber are E. H. Nelson, general manager Griscom-Russell Company, who was named first vice president, and E. H. Birney, president Peerless Drawn Steel Company, who was elected second vice president.

Edward Francis Carry, president Haskell-Barker Car Company, Michigan City, Ind., recently purchased by the Pullman Company, was made president of the combined concern on January 16. J. S. Runnels, retiring president of the Pullman Company, becomes chairman of the board. Mr. Carry started his car building career at the age of 21, as stenographer for Wells & French.

William P. Chinn, assistant general manager of mines for Pickands, Mather & Company, Cleveland, has been promoted to general manager, succeeding C. H. Munger, who has been general manager of mines as well as secretary of the company, but whose duties at Cleveland have necessitated his full attention as secretary. William A. Rose, chief mining engineer of the company, has been made assistant general manager of mines. Mr. Chinn has been with the Pickands, Mather organization since 1901, prior to which he was bookkeeper at the Elba mine, on the Mesabi range, of the Minnesota Iron Company. Soon after Pickands, Mather & Company took over the mine, Mr. Chinn

was made superintendent and four years ago was made assistant general manager of mines. Mr. Rose has been chief mining engineer for the company for the past eight years.

J. A. Connely, manager of the Tampico, Mexico, office of the Petroleum Iron Works Company, Sharon, Pa., effective January 1, became sales manager of the company with headquarters at Sharon.

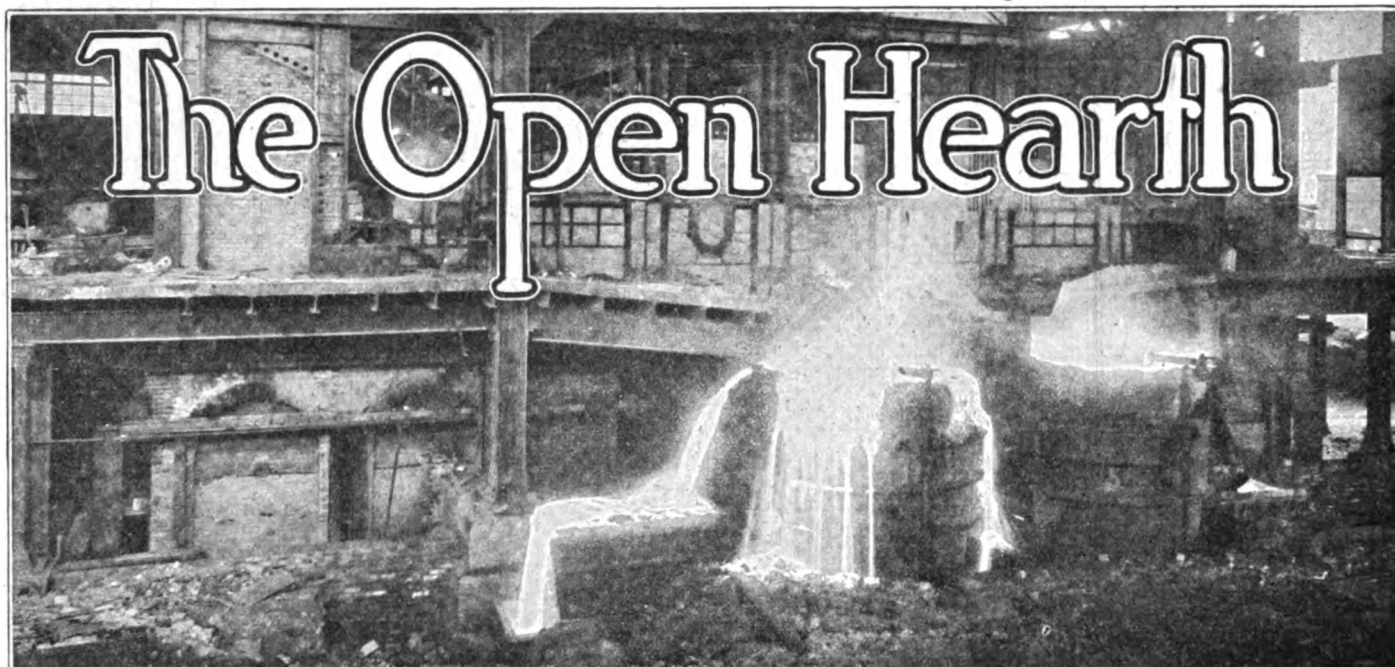
John H. Mowrey, assistant manager of the order department of the Lorain Steel Company, Johnstown, Pa., for 12 years, has resigned to become associated with his father as junior partner in the John I. Mowrey Coal & Lumber Company, Spring City, Pa. Eighteen years ago Mr. Mowrey joined the Lorain Steel Company as private secretary to Daniel Coolidge in the Philadelphia office.

James H. Hammond, president of the Superior Steel Corporation, Pittsburgh, for 24 years and chairman of its board for the past five years, has resigned from the company, along with three others, Henry F. Devens, formerly vice president and recently special agent for the company; Henry D. Sarge, secretary and assistant treasurer, and Frank D. Frost, assistant sales manager.

Bruce Haines, assistant manager Crawfordsville Wire & Nail Company, Crawfordsville, Ind., has resigned and will become general manager of the Davenport, Ia., branch of the Nichols Wire & Sheet Company, Kansas City, Mo.

Edward M. Adams will be first vice president and general manager of sales of the Inland Steel Company, succeeding G. H. Jones. Walter C. Carroll will be vice president in charge of sales for the sheet division, and Charles R. Robinson vice president in charge of sales for the rail and track accessories division.

John J. Brant, general auditor Youngstown Sheet & Tube Company, Youngstown, Ohio, retired December 31. He will continue to make his home in Youngstown, where he has resided since 1885. He was appointed auditor of the company in 1911, having previously been in the auditing and accounting departments. He has served with the company for 20 years.



George Matin has resigned as auditor of the Youngstown Steel Car Company, Niles, Ohio. He had been previously identified with Price, Waterhouse & Ohio Company.

✓ ✓

F. J. Griffiths resigned January 1 as vice president and works manager of the Central Steel Company, Massillon, Ohio. He has been succeeded as works manager by Benjamin Fairless, who has been plant superintendent. His successor as vice president has not yet been named.

✓ ✓

J. H. Hackenburg, purchasing agent Pressed Steel Car Company, Pittsburgh, has resigned and J. B. Tate has been made assistant purchasing agent and will have charge of the department pending the appointment of Mr. Hackenburg's successor.

✓ ✓

Theodore A. Gessler, for the past 13 years manager of sales of the American Sheet & Tin Plate Company, New York, resigned January 1. Mr. Gessler has been identified with the sheet and tin plate trade since 1898, at which time he became associated with the American Sheet & Tin Plate Company in its New York office. He is succeeded by E. E. Winckler, who has been assistant manager of sales in New York since 1909. Mr. Winckler has been associated with the American Sheet & Tin Plate Company since its organization 22 years ago and previously represented the Cambridge Iron & Steel Company, Cambridge, Ohio, in the east, with headquarters in New York.

✓ ✓

Edward Worcester, who retired as vice president in charge of sales of the National Tube Company, Pittsburgh, on January 1, and who is to make his home in the east and serve the company in an advisory capacity, was tendered a farewell dinner at the William Penn Hotel, Pittsburgh, Thursday evening, January 5, by his former associates in the general offices and by the mill managers. William B. Schiller, president National Tube Company, was toastmaster.

✓ ✓

Lloyd Jones, chief engineer United Engineering & Foundry Company, Pittsburgh, has resigned. He has been with the company for about nine years, having become chief engineer when F. C. Biggert was elected president a few years ago. His successor has not yet been named.

Dean R. Wilson has resigned as vice president and treasurer of the Carbon Steel Company, Pittsburgh.

✓ ✓

Judge Samuel L. Black, Columbus, Ohio, was re-elected president at the annual meeting of the directors of the Pittsburgh Tin Plate & Steel Corporation, in Marietta, Ohio, January 6. A. V. Somers was re-elected vice president, treasurer and general manager and O. G. Toner, Eden, Ohio, was named secretary, succeeding A. W. Stump of New York.

✓ ✓

Announcement is made by the Sharon Pressed Steel Company of Sharon, Pa., of the appointment of Mr. William J. Cleary as assistant general sales manager. Mr. Cleary's headquarters will be in No. 1214 Dime Bank Building, Detroit, Mich., and his duties will cover the automotive industry in general.

✓ ✓

Alfred M. Oppenheimer, president of the Apollo Steel Company and a member of the firm of M. Oppenheimer & Company, has been elected a director of the Exchange National bank to fill the vacancy caused by the death of Albert H. Childs.

✓ ✓

William K. Singleton, general manager of sales of the Carnahan Tin Plate & Sheet Company, Canton, Ohio, effective January 15, became identified with the tin plate division of the American Steel Company, Pittsburgh.

✓ ✓

Edward H. Bindley, who is vice president and director of the Pittsburgh Steel Products Company and who has been vice president and director of the Neely Nut & Bolt Company, Pittsburgh, has been elected president of the Neely company in succession to his father, the late John Bindley. At the recent annual meeting of the Neely Nut & Bolt Company R. A. Lackner, secretary, treasurer and general manager of the company, was elected vice president, treasurer and general manager, and Albion Bindley, formerly a director of the Neely company, was elected secretary.

✓ ✓

Frank A. Weidman, who for 12 years was affiliated with the American Sheet & Tin Plate Company, Pittsburgh, latterly as a member of its special agents' department, became identified with the Inland Steel Company, Chicago, on January 15, as special representative.

WITH THE EQUIPMENT MANUFACTURERS

BOWSER & COMPANY ANNOUNCE A PISTON—TYPE "VISIBLE" GASOLINE PUMP

Of five-gallon capacity, this new pump is based on the time-proven principle of piston type measurement and incorporates the famous Bowser water separating filter which extracts all moisture from the gasoline discharged. It also has several new features for the protection of the public.

A bell announces the completion of each gallon measurement of the piston stroke. Thus the customer can check the measurement without watching the pump.

To prevent any misunderstanding between seller and buyer as to the amount discharged, large dial indicators record each individual sale.

But the most interesting feature of this pump to the customer is a sight glass located in the discharge arm which permits him to see the gasoline both before and during discharge. Seeing the gasoline through this sight glass before discharge, the purchaser is absolutely assured of accurate measurement. Seeing the gasoline flow through the sight glass into the hose leading to his car, he is again assured that he is getting all of the gasoline discharged by the pump.

This pump is power operated by air pressure on an auxiliary cylinder which makes the power application absolutely safe in connection with gasoline. It is also arranged for hand operation. All driving parts run in oil, assuring long life and easy operation.

While this new pump adheres to the piston-type measuring principle, for which Bowser & Company have always stood, it affords every virtue of "visibility," with no sacrifice of safety, either to buyer or seller, in the handling of gasoline.

CLEVELAND CRANE & ENGINEERING COMPANY COMPLETES BIG CRANE FOR ARMOR PLANT

One of the most interesting engineering accomplishments for the year is the completion of the huge crane that the Cleveland Crane & Engineering Company of Wickliffe, Ohio, undertook to build for the U. S. Government armor plate plant at Charleston, W. Va.

When it is realized that the runway of this crane is 165 feet above ground—a distance equal to a 15-story office building—and the pit is 100 feet below the floor level, the unusual conditions that had to be met become somewhat apparent.

The crane has a span of 104 feet, a capacity of 75 tons, and is driven by two 200-hp. motors. The hoisting speed is 50 feet per minute, fully loaded, and the lowering speed is 100 feet per minute under the same conditions. Very excellent indeed for a crane of this size.

Another interesting feature of its design that engineers should note is its ability to stop a full load descending at the rate of 100 feet per minute in the unusually short space of a single foot.

The crane is of the double bridge drive type and is pulpit operated. Further details will be gladly furnished to those interested by the makers of the crane.

POWER LIFTING AVAILABLE FOR EVERY LOAD MOVING JOB

To provide an electric hoist for every load moving job, small

as well as large, is the purpose of the Liftabout, a small general utility hoist recently announced by the Shepard Electric Crane & Hoist Company, Montour Falls, N. Y. The possible uses of the Liftabout are well suggested in its name for it can be applied to advantage in lifting most anything and carrying it most any place. Heretofore many have been under the impression that an electric hoist could be used only for the big, heavy re-handling jobs and that it was not adaptable to the smaller ones. The Liftabout is particularly designed and suited not only to usual lifting jobs encountered in factories, mills and warehouses, but also for the more specialized jobs in apartment houses handling ashes, in ice plants pulling the heavy cans, in slaughter houses expediting the kill and in garages raising chasses. Wherever hand labor is now employed on any job of lifting, carrying and putting down the Liftabout affords a new and far more economical means of doing the work.

In use the Liftabout is most versatile for it can be operated wherever electric current is available and is easily installed on the side of a building, on the ceiling of a basement, or in any point that will bear the weight of a load. One man—any man—can run a Liftabout and with it he can do the work of many, much more rapidly and with far greater efficiency.

On most any load moving job the savings in time and labor that this mechanical means makes will quickly refund its modest initial cost. In developing and marketing this product the Shepard Company has undoubtedly broadened the field where electric hoists may be effectively applied.

SOUTHWARK AUTOMOBILE-BODY PRESS

The Southwark Foundry & Machine Company, Philadelphia, Pa., has recently developed an all-steel hydraulic press, particularly for use in the manufacture of automobile bodies. The press has a capacity of 450 tons. The main ram is located in the lower base, to which are secured the four columns. One clamping platen and one stripper platen are provided.

The stripper platen carries four hydraulic cylinders, which act upon a forged steel plate, which in turn carries 60 stripper pins $1\frac{1}{2}$ in. in diameter and projecting through the clamping platen. The clamping platen itself is a solid steel casting, and is provided with T-slots. The top platen carries eight hydraulic jacks used for clamping, each having a 5-in. ram and 5-in. stroke. The position of the top platen is adjustable, so as to suit various sizes of dies.

The press is controlled by a single-lever operating valve, which first admits low pressure to the four jack cylinders and at the same time low pressure to the main ram. As soon as the dies come together, high pressure is admitted through the steel operating valve, thus forming the work to whatever shape is given it by the dies. The clamping cylinders are controlled automatically from the low-pressure filling tank, and are capable of standing an hydraulic pressure of 5,000 lbs. per square inch. The press has a die space of 7x5 feet, and the vertical opening between the platens is 18 in. as a minimum and 4 feet as a maximum.

TRADE NOTES

The Boston office of the Cutler-Hammer Manufacturing Company, Milwaukee, has been moved from the Columbian Life Building to Rooms 403 and 404 Harvey Building, Chancy street. Mr. C. W. Yerger is manager of this office.

The R. H. Beaumont Company, Philadelphia, contractors for coal, coke and ash handling systems at boiler houses and gas plants, are increasing their sales force as follows: Mr. P. K. Reed, formerly chief engineer, will enter the sales department and will be located at Philadelphia. Mr. H. D. Williams, a former engineer, will enter the sales department and will be added to the New York office force. The company's Pittsburgh office will move to the Oliver building and will be in charge of Mr. Charles W. Ross. Mr. Ross was formerly New York manager. All of these men are well trained in the fundamentals of coal, coke and ash handling equipment and are prepared to serve plant managers quickly and efficiently in all problems of this nature.

The City of New York Department of Docks has announced the award of contract to the Wellman-Seaver-Morgan Company of Cleveland, Ohio, for 34 cargo handling cranes. This will be the largest installation of dock cranes ever undertaken on this side of the Atlantic. The cranes are to be in operation within one year from date of award of contract. They will be installed on Piers 12 and 13, known as the Pan-American docks, at Stapleton, Staten Island.

F. J. Ryan & Company, Wesley Building, Philadelphia, announce the receipt of the following contracts: Bath Iron Works, Bath, Me., for the installation of Mirco system of fuel oil burning on bar and plate furnaces; Commonwealth of Pennsylvania, Prison Labor Bureau, Huntingdon, Pa., three electric oven equipments to be used in the process of baking of automobile tags; Philadelphia Spring Works, Philadelphia, Pa., one oil fired spring fitting furnace and one oil fired drawing furnace.

Combustion Engineering Corporation announce the opening of a new branch office at 306 First National Bank Building, Pittsburgh, Pa. This office will be in charge of Mr. W. C. Stripe, formerly manager of our Philadelphia office.

The Orton & Steinbrenner Company of Chicago, manufacturers of locomotive cranes, clam shell and orange peel buckets, have made arrangements with Walter Hasendahl, 1213 Fuller avenue, Los Angeles, Cal., to represent them.

Mr. W. B. Wachtler, until recently manager of the Chicago district for the Industrial Bearings Division, Hyatt Roller Bearing Company, has been promoted and

transferred to the New York headquarters of the division as engineer in charge of general applications.

The Wilson Welder & Metals Company have moved their general offices and Bush Terminal factory to 132 King street, New York, N. Y. They have installed additional facilities which will enable them to handle their business in certified plastic arc welding metals in addition to Wilson plastic arc metals.

W. S. Rockwell Company announce that Gibbons Bros., Ltd., Dudley, Worc., England, has been appointed their representatives for the British Isles.

The friends of C. H. Davies will be interested to learn that he has severed his connection with the S. F. Bowser Pump & Tank Company, with whom he has been associated the past 16 years. Mr. Davies has already taken up his new duties with the Citrus Products Company of Chicago and will be in charge of advertising and marketing, for which work his previous experience has so well equipped him.

The Hyatt Roller Bearing Company, New York City, has been awarded the contract to furnish Hyatt mill table bearings for the main tables of 34-inch blooming mill of the Allegheny Steel Company, Brackenridge, Pa. The Allegheny Company has for several years operated the tilting tables of the 100-inch plate mill with the Hyatt type of bearing on all table rollers and line shafts.

R. D. Wood & Company, Philadelphia, which for many years has been manufacturing hydraulic machinery and gas producers, will continue active in this business, notwithstanding the recent sale of the equipment of the Camden Iron Works, of which the former were owners. The sale made by the receivers of the Camden Iron Works does not affect the plans of R. D. Wood & Company for continuing in the manufacture of hydraulic machinery, gas producers, etc., in which it has been prominent for more than 30 years, that company states.

The Northern Indiana Gas & Electric Company has decided upon extensive improvements to the several plants of its system and contracts have been awarded for this work to the U. G. I. Contracting Company of Philadelphia. The work includes an outdoor sub-station with switching equipment, three 1667-kva. transformers and a 2500-kw. frequency changer at Hammond, switching equipment and reactors at East Chicago and a 2000-kva. synchronous condenser, outdoor sub-station and switching equipment at Michigan City. At the Fort Wayne gas plant new washer-tar batters and connections are to be installed.

Mutually satisfactory arrangements have been made between the Combustion Engineering Corporation and the George J. Hagan Company of Pittsburgh, whereby the Hagan Company discontinues represen-

tation of the Combustion Engineering Corporation. The Combustion Engineering Corporation has opened its own office in the First National Bank Building, Pittsburgh, Pa., and will soon open an office in Cleveland, Ohio, both of which will be in charge of Mr. W. C. Stripe, former manager of the Philadelphia office.

TRADE PUBLICATIONS

The Uehling Instrument Company have recently developed a very efficient filter intended primarily for supplying clean flue gas to their CO₂ recording equipment. The filter proper is made of a very highly refractory material and is remarkably efficient for its purpose.

"The Romance of Wire Rope," by John K. Mumford, is the title of a 137-page illustrated book recently published by the John A. Roebling's Sons Company. The book is written in a popular way, understandable to the layman and in no meaning of the term is it technical. It is historical to a certain extent and is very interesting.

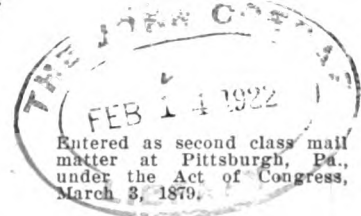
The Pennsylvania Pump & Compressor Company of Easton, Pa., have just issued a new bulletin covering their single stage, straight line, air compressors and vacuum pumps in both belt and steam driven types. In addition to the description of their equipment, the booklet is quite complete as to the table of standard sizes and other essential data. A copy will be sent upon request from the company.

The Mesta Machine Company have issued Bulletin "U," covering their Una-Flow engines built under Stumpf patents. The bulletin covers Una-Flow mill engines, Una-Flow blowing engines and Una-Flow power engines. A copy will be sent upon request to the company.

Babbitting motor bearings is described in detail in Circular Reprint No. 104, published by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. The publication is a discussion of the production of babbitt metal by J. S. Dean, of the Railway Motor Engineering Department, Westinghouse Electric Company, and it contains a number of photographs of equipment used in the manufacture of babbitt metals as well as the results of various tests of samples of alloys.

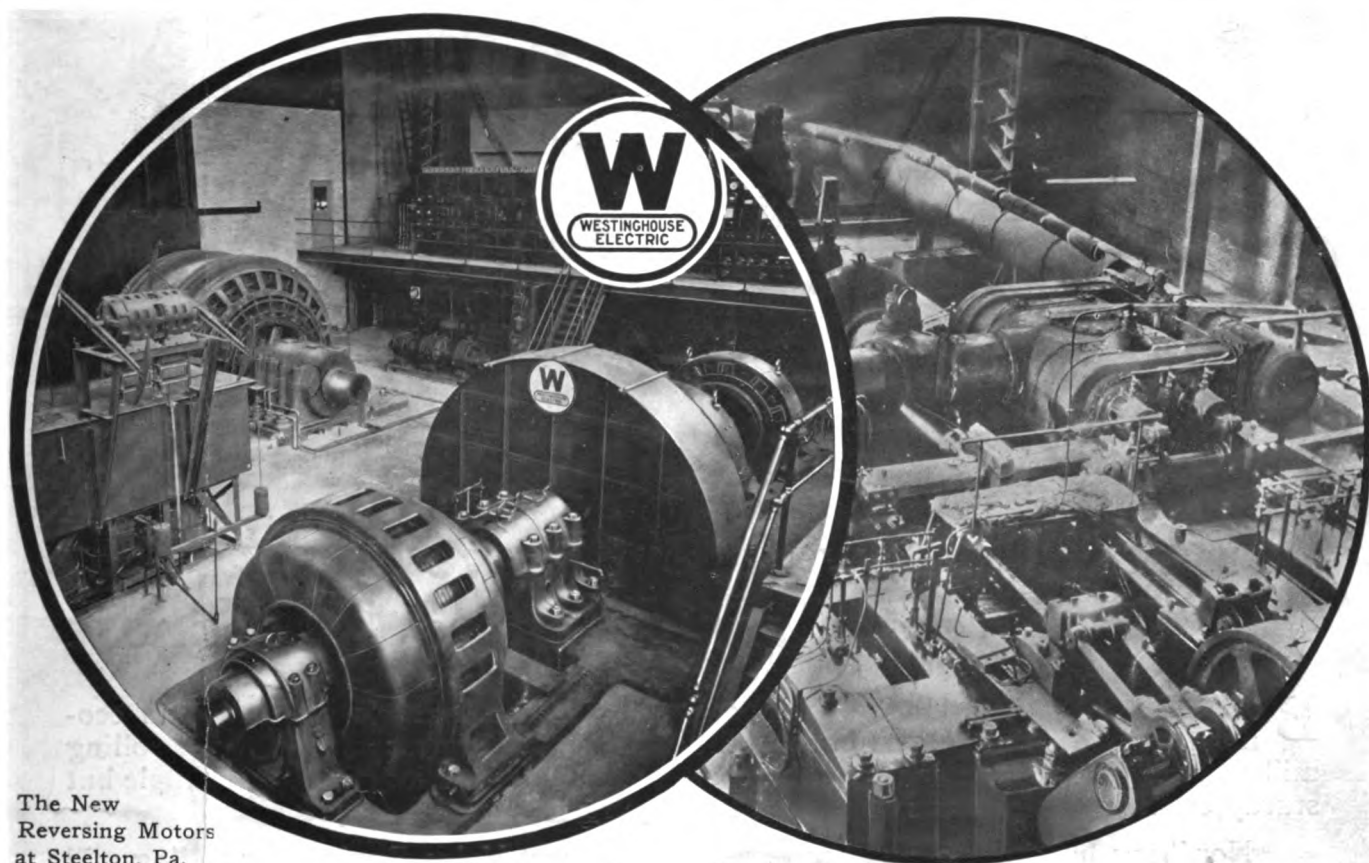
A new bulletin on the Quigley Fuel Systems, comprising methods of preparing, transporting and burning of pulverized fuels has just been published by the Harding Company, 120 Broadway, New York. This bulletin is known as No. 12 and treats the subject of pulverized fuels in a manner never before attempted. One of its distinguishing features is the fact that emphasis is laid upon the methods employed to properly prepare and burn the powdered coal, rather than occupying most of the space discussing the pulverizer.

66
Member of the Audit Bureau of Circulations.



The Blast Furnace *and* Steel Plant

Pittsburgh, February, 1922.



Electrification brings to the steel mill, as it does to all industry, the sound economies demanded today and even greater and broader economies for the future.

The Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.

Westinghouse